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From the desk of Chairman

Dear Coconut farmers,

Coconut palm is an important horticultural crop cultivated by the small and marginal farmers scattered in 17 states and 3 union territories in the country. Eulogized as 'Kalpavriksha', the crop has been in existence in the country since the past 3000 years. Coconut, the fruit of the palm is used in all religious and social functions in some way or the other throughout the country and has become the symbol of Indian culture.

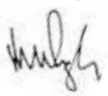
India is the largest producer of coconut in the world with a share of 31%. The crop plays a significant role in poverty alleviation and employment generation especially among the weaker sections of the society. It provides livelihood security to 12 million farm families and owns a 6% share in the edible oil output in the country. The kernel of coconut is a nutritious diet. Tender nut and neera are the most sought after natural drinks of people across the country. Coir, the versatile fiber from coconut provides employment to a large number of rural women. Coconut and coconut products including coir earns a foreign exchange of around Rs.3000 crores annually through export.

Coconut Development Board was established as a statutory body by an Act of Parliament viz Coconut Development Board Act 1979 for the integrated development of coconut industry. Formation of CDB in 1981 was a breakthrough in the history of coconut development in the country. Considerable improvement in expanding area under coconut and technology development for new product development could be achieved through the various development programmes implemented by the Board in the country. The fact that nearly 50% of coconut production is consumed as raw nuts shows it's importance as a food crop. Versatile uses of coconut as oil seed, beverage, fiber and timber is improving the demand of coconut in the country and is likely to go up in the years to come. Accordingly CDB is formulating strategies from 2016-17 onwards to meet the future demand of coconut in the country.

This special issue of Indian Coconut Journal devoted to the coconut farmers is being brought out to mark 100 years of coconut research. Board is hopeful that this issue would throw a relook into the 100 years of research work undertaken for enhancing coconut production and productivity, processing and value addition. I am sure that the journal would help in disseminating vital information on coconut research among the researchers, development agencies, extension workers and entrepreneurs in the country.

With warm regards,

A K Singh



Chairman

Path of Glory

# of Coconut Research in India

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Introduction

The evolution of coconut research in India has its roots in the culture, identity and lives of many. The research aspects of coconut can never be viewed as a unilateral component because of the essential social-embeddedness the sector is sharing. It is an indubitable fact that the coconut sector in the country, over the last 100 years had experienced tough times, moments of pride, moments of tears as well as excellence in research and development. The striking feature of the sector is that, it has come out much stronger edging out the adverse periods. The contribution of research facet to the sector is invaluable. As an accepted fact, the research on long duration plantation crops like coconut is always tough, and many a times comes under severe criticism. Having this in mind, the efforts in the research front of coconut is indeed worth adulation. Since the coconut research in the country reached the 100th year, it is the right time to have retrospection on the journey of coconut research in the country.

Setting up the premises: an earlier period

In accordance to the report of the Famine Commission 1901, the Imperial Government of India sets up a Central Department of Agriculture and agriculture departments in the provinces to primarily look after agricultural enquiry, agricultural development and famine relief in the country. However, it was only after 1905 that with the reorganization of the agriculture department, agriculture research was organized on a more systematic line,realizing the need to explore and develop further income resources from agriculture and for sourcing raw materials for the industrial England on a long term basis.In consideration of the unlimited opportunities that the vast and agro-ecologically diverse empire offered,agricultural experimental stations were started in the most important agricultural tracts.In line with this development, three separate blocks of vacant land in and around the village of Nileshwar (Nileshwar I (Pilicode), 15 acres), Nileshwar II (20 acres), Nileshwar III (20 acres) and an existing coconut garden in Kudlu Village (26 acres) (all in the present day Kasaragod district of Kerala state, India) were acquired in order to obtain representative soils, on which coconuts were generally cultivated on the West Coast and thus four sub-stations have now been started in the South Kanara district of erstwhile Madras Presidency.

Initiating the scientific research: The beginning

The three blocks out of the four acquired for coconut research were vacant lands and naturally it takes several years for the well-laid experimental plots to be available for laying out new experiments, the standing coconut crop (though not scientifically planted) in the newly acquired Kudlu block (where the present CPCRI is located) was used for initiating preliminary experiments as a trial-run for collecting valuable data for proper planning of future experiments.Coconut being a crop fairly unfamiliar to western science, initial attempts was to study the morphology of the palm, its floral biology, manurial operations and cultural practices, introduction of varieties etc. By all records, probably this must be the earliest case of organized systematic research on coconut the world over.

One can see the blueprints in these early experiments, on which systematic investigations were conducted in later years. The early observations of palm-to-palm variation in growth and yield, and enumeration of yield contributing characters have led to the concept of pre-potent palms and careful selection of such superior individuals in a population has given most promising rewards in later years. The investigations on crown morphology elucidating the right hand spiral and left hand spiral arrangement of leaf whorls and the classical study on the coconut root system and its feeding area are phenomenal. The need for collecting good seed nuts from select palms and selecting good seedlings at nursery stage based on a set of criteria especially the split leaf were emphasized as early as 1918. A series of manurial experiments were started to understand the nutritional requirements, the absorption pattern and the optimum methods of supplying them. The benefits of growing green manure crops and soil moisture conservation by mulching were recognized in the early years.

Pioneering the coconut demonstration plots

Laying out demonstration plots in research stations and farmer gardens as a way of demonstrating and convincing farmers to adopt technologies had always been a key extension strategy. Strikingly, the Annual Report of the Coconut Stations in Kasaragod as early as in the year 1921 reported the advantages of intercultivation. The Annual Report (1923-24) states "the ryots having realized the superiority of our seedlings are coming forward with their applications not only from the West Coast districts, but also from other parts of the Presidency". "There has been a considerable awakening in the South Kanara district to the possibilities of coconut types. When the coconut trees were once established, it was the practice to give no further attention to them. The methods adopted at the Kasaragod station, where a large increase in crops has resulted from after treatment, have led to considerable interest and imitation and the district staff stationed in this district have done all in their power to bring our improved methods to the notice of the cultivators" . This evidence clearly highlight the wisdom of the earlier committed workers in coconut research, who indeed initiated cutting edge transfer of technology techniques in those times.

Dr. J.S. Patel

The first coconut hybrid: A land mark

The development of hybrid varieties involving tall and dwarf types possessing prolificity and precocity is a major landmark in the annals of coconut improvement. It was the pioneering work of Dr. J.S. Patel and his team that paved the way for the exploitation of heterosis in coconut. The first hybrid was produced by crossing local West Coast Tall with the Chowghat Dwarf Green and the hybrids were planted at Nileshwar in 1934 for evaluation. Since then, six coconut hybrids have been developed/ released from CPCRI, a mammoth achievement in itself, considering that developing and evaluating a new hybrid in a perennial crop like coconut takes about two decades. The demand for hybrid seedlings of coconut have ever been on the increase and now large scale production programmes are in progress to meet the increasing demand.

Central Plantation Crops Research Institute, Kasaragod

Phase of Transition: Indian Coconut Committee

Coconut research had been the responsibility of only the State Departments of Agriculture until 1945, when the Indian Central Coconut Committee (ICCC) was constituted to coordinate research and development activities at the national level. The committee took over the Kasaragod (Kudlu) research centre and developed it in to the CCRS, Kasaragod and the other three field stations remained with state department of agriculture and later handed over to Kerala Agricultural University in 1972. The Central Coconut Research Station (CCRS) at Kayamkulam was established in 1948 by the Indian Central Coconut Committee.

During the first phase, at CCRS Kasaragod, the area was increased to 100 acres by acquiring additional land. Research was reorganized under four disciplines, namely agronomy, botany, cytogenetics and analytical chemistry. The next phase of development of CCRS began in 1958 with the implementation of the Second Five Year Plan. By early 1960, the activities of the Institute expanded and the staff strength increased along with other infrastructural facilities. During this period, the main thrust was on survey and identification of indigenous germplasm, laying out of large-scale fertilizer trials, crop weather studies, survey of coconut soils of Kerala, cytological and anatomical studies, studies on button shedding and barren nut formation, preliminary studies on irrigation, lime requirement in coconut soils, seednut storage, etc. The achievements made by the CCRS with the minimum basic facilities and manpower available are stupendous. The significant contributions made towards gathering basic knowledge about the palm and the vast data collected in those days still form the basis of current research programmes.

Institutionalizing the research

The Indian Council of Agricultural Research (ICAR) took over the administrative control of CCRS at Kasaragod and Kayangulam from 1st April, 1966 following the abolition of the Commodity Committees. Since then, it was felt that the CCRS cannot exist by itself at an all India level, the then Director-General, late Dr. B.P. Pal, F.R.S. and the Secretary, ICAR, Dr. K.P.A. Menon visited the CCRS Kasaragod and CARS Vittal and discussed the pros and cons of amalgamating these two Stations along with the Research Centres of CARS into an All India Research Institute for the agricultural plantation crops (excluding tea, coffee and rubber). Thus, the Central Plantation Crops Research Institute (CPCRI) came into existence in January, 1970. The Central Arecanut Research Station (CARS)Vittal along with the five substations under the Indian Central Arecanut Committee was also merged with the new entity. With the establishment of Central Plantation Crops Research Institute (CPCRI) in 1970 at Kasaragod, the CCRS Kayamkulam and CARS, Vittal were designated as regional stations.

Subsequently, the administrative control of the two ICAR Research Complexes in Goa and Lakshadweep were also transferred to CPCRI in 1976. A scheme for initiating research on spices was sanctioned by lCAR

Kalpajyothi

Kalparaksha

Chowghat Orange Dwarf

during the Fifth Five Year Plan and CPCRl set up a new Regional Station at Calicut in 1975 with the laboratories at Chelavoor and the farm at Penivannamuzhi for conducting research on pepper, ginger, turmeric, clove, cinnamon, nutmeg, allspice and vanilla. It was thus entrusted with the responsibility to co-ordinate the research efforts in all important plantation crops like arecanut, oil palm, cashew, cocoa, cardamom, pepper and other spices, besides coconut.The All India Co-ordinated Coconut and Arecanut Improvement Project and Cashewnut and Spices Improvement Project came into operation with effect from 1-10-1970 and 2-12.1970 respectively.The network was further strengthened in the later years. The AICRP on Palms has at present 15 centres on coconut, four on arecanut, eight on oil palm and two on palmyrah, covering the important cropping tracts.

Indian Society for Plantation Crops:A meaningful agglomeration

With the establishment of Central Plantation Crops Research Institute in 1970, the scattered and isolated units carrying out researches on individual plantation crops were brought together under a single agency of ICAR, with the possible exception of coffee, rubber and tea (for which separate research institutions were already there in place). Consequent to the inception of the Institute, it was felt that a common forum be established to bring together all scientists working on these crops so as to facilitate free exchange of ideas and experiences. The Indian Society for Plantation Crops (ISPC), a professional forum devoted to sustainable growth and development of plantation crops sector, was thus established in 1971 with headquarters at Kasaragod and this society has presently metamorphosed into one of the premier scientific societies in India. Its main activities are publication of the Scientific Journal, Journal of Plantation Crops (JPC), holding National and International Symposia (PLACROSYM) and encouraging original research by instituting various awards.The forum for scientific communication in the sector was initiated through the Journal of Plantation Crops (JPC), as a multidisciplinary journal, aims at dissemination of research findings in plantation crops (coconut, arecanut, cocoa, cashew, oil palm, coffee, tea, rubber, date palm), including cropping systems, as well as various spices. Since its inception in 1973, 42 volumes have been published. The journal is published thrice a year during April, August and December and

Plantlets from Embryo culture Cryopreservation of embryos and pollen

publication of the articles is subject to peer reviewing and recommendation by experts in the field.

Garnering the germplasm: Way back in 1981

Survey and collection of coconut germplasm in Pacific Ocean territories was undertaken in 1981 with the financial assistance from IBPGR/FAO. A scientific team was deputed to Solomon Islands, Fiji, American Samoa, Western Samoa, Tonga and French Polynesia and they collected 2500 nuts from 23 sites from these countries. The collection consisted of 20 Tall types and four Dwarfs. These include types known in the literature as 'Rennel Tall', 'Solomon Tall', 'Fiji Tall', 'Samoa Tall', 'Tahiti Tall', 'Rangiroa Tall' and 'Dwarf Yellow' (American Samoa) 'Dwarf Orange' ('Rangiroa', also known as 'Hari Papua') and 'Niuleka' (Dwarf Fiji). Two tall types, 'Bulundrau' (Fiji) and 'Takovs' (Tonga) having large number of small nuts (comparable to 'Laccadive Micro' of India) was also collected. These collections were initially planted at the newly established World Coconut Germplasm Centre in Andamans and subsequently most promising selections from the original collections were relocated to the ICG-SA at the CPCRI Research Centre, Kidu in Karnataka.

Though coconut germplasm was introduced in India from south and south east Asia several times in the past as early as 1924, this is the first case of a scientific exploration mission to outside India. This mission to the region considered to be the 'original home of coconut' has turned out to be highly rewarding, as these precious collections were the foundation material from which several new hybrids/selections were developed / released in recent times and still more are in the testing line.

Strategic Breeding: Focus on dwarf hybrids

Early attempts were at developing tall varieties and T x D hybrids considering their higher yield potential and oil percentage, hardiness and adaptability to varied climatic and edaphic conditions. Of the nineteen coconut varieties and hybrids developed by CPCRI so far, nine of them are either tall or T x D hybrids.Now, in the present scenario of acute shortage of palm climbers and the increasing demand for tender nuts and also neera tapping, there is a rethinking in the breeding strategies, with the emphasis now placed on developing dwarf varieties and D x T hybrids suitable for tender nut and also dual purpose (conventional copra/oil and tender nut purpose). Apart from the Chowghat Orange Dwarf released in 1991, the recently developed varieties like Kalpa Surya and Kalpa Jyothi (as exclusive tender nut varieties), are a welcome step in this direction. Incidentally, the ICAR-CIARI, Port Blair has recently released four dwarf selections (Annaporna for copra purpose, Chandan, Surya and Omkar for ornamental and tender nut purposes)from the exotic germplasm of Pacific region conserved by CPCRI at the erstwhile WCGC, Port Blair (now under ICAR-CIARI).

Another facet of the present breeding strategy is to look for other desirable traits like suitability for value addition

Plantlets regenrated from plumule

Coconut based cropping system integrating with black pepper, banana, tubers and vegetables

and/or biotic and abiotic stress tolerance, apart from the traditional emphasis on yield potential. Kalpa Pratibha, Kerachandra and KalpaHaritha are recommended as dual purpose varieties suited for both copra and tender nut purpose. Kalpatharu is recommended as a ball copra variety, owing to minimal spoilage and higher recovery percentage of ball copra. The varieties, Chandra Kalpa, KalpaMitra, KalpaDhenu, KeraKeralam and Kalpatharu are also relatively tolerant to drought. Kalparaksha and Kalpasree are recommended for root (wilt) affected tracts as disease tolerant varieties.

Clonal propagation is still issue although success met with embryo culture, cryo preservation and hybrid authentication

Tissue culture of coconut was initiated in 1977 at CPCRI. Although coconut plantlets have been regenerated and successfully established in the field, a commercial scale protocol has not been achieved and conversion of somatic embryos into plantlets has remained as one of the major bottlenecks.Due to recalcitrant nature and bulkiness of seeds, the collection of coconut germplasm from far off places is difficult and costly. A successful protocol has been developed for efficient in vitro culturing of coconut embryos and plantlet regeneration.

Cryopreservation techniques have been standardized for mature coconut zygotic embryos and pollen. Since coconut is a perennial crop, which takes longer periods for stabilized yield, the quality of the planting material is significant for the successful cultivation. Morphological markers such as germination rate and colour of the petioles are used in selecting hybrid seedlings in the nursery.

Morphological marker based screening often lead to confusion since many cultivars have similar characteristics. RAPD (Randomly Amplified Polymorphic DNA) marker technology has been developed to identify hybrids at nursery stage. The genetic homology of the bulbils from two coconuts growing at CPCRI, Vittal through microsatellite analysis have demonstrated that the use of both primary and secondary bulbil shoots as propagules for producing viable clonal progeny of bulbil-producing palms. If we could get bulbil-shoots induced in our Super Palms too, by 'shooting' with a 'Gene-gun', to activate these 'bulbil-inducing genes'. The "Pollen Gun", with which one can 'shoot' Coconut Pollen from ground level, to pollinate the emasculated spadices located 40 to 50 feet above has been developed.

The wisdom of cropping system approach

Coconut based cropping systems, initially conceptualized and developed in the eighties and further refined in the succeeding years, is a highly versatile, sustainable, profitable system, optimizing the use of available resources. Different models tailor-made for various agro-ecological zones and suiting different requirements of households have also been evolved over the years. The advantage is that you can select the component crops, based on the food preferences and nutritional requirements of the family and optimum income possibilities considering the prevailing market realities. By the latest estimates, a coconut based cropping system using multi species cropping of coconut with pepper, banana, nutmeg, pineapple, ginger, turmeric and elephant foot yam generated a net income of Rs 3.7 lakhs per ha, which is 150% higher than that of coconut monocrop (Rs 1.4 lakhs).

Multi species cropping system has further evolved in to mixed farming system by integrating livestock enterprises in to it. It is a classic case of the society demanding it and the research institution answering the distress call. Of late, the coconut growers are exposed to economic risks and uncertainties owing to the frequent price fluctuations for the produce. In this context, it is needless to emphasize the importance of crop/ enterprise diversification in coconut gardens.



Coconut based integrated farming system integrating dairy, goats, poultry and aquaculturen and production of biogas




Drip fertigation, mulching with coconut husk and bund reinforced with pineapple planting

The research at CPCRI clearly indicated the scope for integration of crops and animals in the coconut garden for enhancing income and providing employment throughout the year. The system, thus developed, is a closed one, requiring less farm inputs and gives importance to recycling of produces/ wastes among the components in the system. It facilitates high input use efficiency and energy-efficient practices through proper linking/integration of different components and intelligent management of available resources. Besides enhancing coconut yield, there was substantial improvement in soil and plant health status, soil physical properties and soil biology, thereby making CBIFS more economically feasible and ecologically sustainable. Added attraction is that subsidiary income is also realized from all the component units. As per the recent investigations, a coconut based mixed farming system (CMFS) comprising coconut, pepper, banana, fodder grass, crossbred cows, poultry birds, goat, and pisciculture generated a net return of Rs 5.5 lakhs, which is 288% higher than that of coconut monocrop.

Plant growth promoting rhizobacteria: New paradigm

Plant growth promoting rhizobacteria (PGPRs) are now being considered as new microbial resources for enhancing crop productivity. They are known to possess multiple plant growth promotion and systemic disease resistance induction properties. Bacillus megaterium isolated from coconut rhizosphere has been released under the brand name 'KeraProbio' for production of healthy and vigorous seedlings of coconut. Its inoculation has shown to give 30-38 % increase in total dry matter of coconut seedlings.

Per drop and more crop

Drip fertigation reduced the use of chemical fertilizer from 50 to 75 per cent with increase in yield by 35-40 per cent. Bund reinforced with pineapple planting and providing catch pits could enhance coconut yield upto 60%.Trench and mulching with coconut husk conserve the soil moisture and improves the yield considerably.

Converting wastes into wealth

About 6-8 tonnes leaf wastes is produced annually from per hectare coconut garden.As much as 4000 kg of good quality vermicompost can be produced from the wastes generated from 1 ha of coconut garden every year using African Night Crawler (Eudriluseugeniae). It converts coconut leaves into vermicompost in less than three months period and compost has C: N ratio of 10-17, 1.8 to 2.1 % N, 0.21 to 0.3 % P and 0.16 to 0.4 % K and organic carbon content of 18-20.

The vermicompost produced from coconut leaves using the technology developed at ICAR-CPCRI is now available by the trade name 'Kalpa Organic gold'. Fresh coconut leaf vermiwash is alkaline and contains major

Vermicompost from coconut organic wastes

Recylcing of organic wastes: vermicompost, vermi-wash and composted coir pith

and minor nutrients, growth hormones, humic acid and plant beneficial bacteria. Coconut leaf vermiwash acts as a plant growth stimulator. A simple technology has been developed at ICAR-CPCRI for conversion of coir pith having a C:N ratio of 100:1 to acceptable manure that does not involve addition of urea. The coir-pith compost produced by ICAR-CPCRI technology is light weight, dark coloured porous product with pH in the range of 6.1 to 6.9 and having up to 500% water holding capacity. The N, P and K content ranges between 1.3 to 1.4, 0.9 to 1.2 and 1.3 to 1.6 %, respectively, and is a good source of micronutrients as well. The coir-pith compost produced using the technology developed at ICAR-CPCRI has been released by the trade name 'Kalpa Soil Care'

Biochar is a charred solid material obtained from thermochemical conversion of plant derived biomass in an oxygen limited environment. Attempts have been made to produce biochar from coir pith and immature coconut (tender nut) husk, a waste produced from coir industries and tender nut parlours, respectively, using a charring kiln.

Coconut by-products such as leafstalk, bunch waste, leaflets has been successfully utilized for production of oyster mushroom (Pleurotusflorida), Wastes generated from 1 ha area of coconut can yield about 1700 kg of fresh mushrooms. The spent mushroom substrate obtained after mushroom cultivation can be used to produce compost/ vermicompost for use as soil organic amendment

Root (Wilt) Disease: The breakthrough

A breakthrough in the etiology of root (wilt) disease of coconut was accomplished in the 1980s. Through systematic research, the involvement of fungi, bacteria, virus, viroid, nematodes and soil factors in the incidence of the disease was already ruled out. Mycoplasma Like Organisms (MLOs) were detected under electron microscope in ultra thin sections of developing leaves, unopened inflorescences, root tips, and terminal bud tissues (in the sieve tubes of phloem) in coconut root (wilt) affected palms and were conspicuously absent in samples from healthy palms. No virus-like particles or microorganisms other than MLOs were made out in these ultra thin preparations. Sample preparations and ultra microtomy were performed at the CPCRI Regional Station, Kayangulam and ultra thin sections were examined under electron microscopes at the Christian Medical College, Vellore, the Cotton Technological Research Laboratory, Bombay and the Institute for Plant Diseases, Bonn, West Germany, where the presence of MLOs was observed in disease affected palms.

The scientific advancements in later years have resulted in redesignation of these 'sub-microscopic non-culturable vascular limited plant pathogenic organisms' more specifically as Phytoplasma, and not MLOs. Successful transmission of the disease by lace bug (Stephanitistypica) and plant hopper (Proutistamoesta) under insect-proof conditions has further established the phytoplasmal etiology. With the advent of polymerase chain reaction (PCR) based detection techniques, molecular characterization in recent years have established the coconut RWD Phytoplasma as belonging to the 16srDNA XI group. Besides, a sensitive, simple and rapid sero-diagnostic test was also developed by the institute to detect the phytoplasma even 6-24 months prior to the expression of visual symptoms.Fortunately, root (wilt) disease of coconut is only a debilitating disease and not a lethal one and as such the health, and yield of palms can be improved/maintained through the adoption of integrated management practices consisting of balanced fertilizers, addition of organic matter, raising green manure crops in the basin and its incorporation,

Black headed caterpillar (Opisinaarenosella) infested coconut and parasitoidsBraconbrevicornis and Goniozus-nephantidis

weed control, leaf rot control and recycling organic matter. In general, apparently healthy palms and those in the early stage of disease respond better to management practices.For ensuring better economic returns and for a sustainable family farming, farmers are encouraged to adopt integrated cropping/farming systems.

Biological control: A land mark in pest management

Plant protection in India, and for that matter most of the developing countries in general, was mainly based on the use of chemical pesticides. Chemical control is, of course, one of the effective and quicker method in reducing pest population, where farmer gets spectacular result within a short time. However, over reliance and indiscriminate use of pesticides resulted in a series of problems in the agricultural ecosystem mainly, the development of resistance to insecticides, pest resurgence, outbreak of secondary pests into primary nature, environmental contamination and residue hazards, destruction of natural enemies of insect pests etc. All these problems contributed to developing a new way of pest control, i.e. the integrated approach of pest control. "Integrated Pest Management is an ecological approach in which utilization of all available techniques of pest control to reduce and maintain the pest population at levels below economic injury level". Though Integrated Pest Management (the term IPM was introduced by R.F. Smith and R. van den Bosch in 1967) was adopted as a policy by various world governments during the 70's and 80's, including the USA in 1972, India declared IPM as official policy only in 1985.

The importance of pest control in crop husbandry was recognized in the early days itself and initial investigations were on developing chemical control regimens for major pests of coconut. Concurrently, investigations were intensified for exploring natural enemies and standardizing their mass production and release in the field. Biological control of the coconut caterpillar,Opisinaarenosella Walker, with the indigenous larval/pupal parasitoids like Braconbevicornis and Goniozus nephantidis became a reality in the 1980s itself.

Though the infection of O. rhinoceros by virus (OrV) was first reported in Malaysia in 1966, a detailed work on it was done in India only in 1983. The population of O. rhinoceros and its damage on coconut palm was checked substantially when the OrV was released/re-released in Minicoy and Androth islands of Lakshadweep, Chittilappillly in Trichur, Kerala, and Sipighat of Andaman Islands. Thus, the success encountered by the use of this microbial pathogen has endorsed its claim as one of the landmark examples in the biological control of an insect pest. M. anisopliae, commonly termed as the 'green muscardine fungus' (GMF), is a well-known entomopathogen. The susceptibility of O. rhinoceros to it was first reported in Western Samoa in 1913 and in India in 1955. M. anisopliae var. major (spore size 10-14 µm) is a highly infective strain used widely for the

Biological control of Rhinoceros beetle a) grub infected with Metarhiziumanisopliae b)Metarhiziumanisopliae spores c) Oryctes rhinocerosnudi virus

control of this pest.

Over time, the classical bio-control has evolved in to IPM, incorporating elements of bio-control, minimal and judicious use of pesticides and cultural practices. It is most gratifying that IPM packages have been developed for all major pests of coconut. The beauty of IPM is that it is not static and it should evolve with the changing pest dynamics, underpinning the need for continuous evaluation and refinement. Presently, efforts are on to develop greener safer molecules as alternatives to many of the chemicals widely used at present,bio-pesticides and bio-agents, with minimum health risk for humans and other living organisms and ensuring a safe and clean environment at large.

Opening up new vista: Semiochemicals in Integrated Pest Management

Deciphering the 'chemical code' of insect communication has revolutionized the science of pest management. Semiochemicals, the signalling molecules used in insect-insect or plant-insect interaction, are now increasingly considered within IPM strategies as an alternative or complementary approach to insecticide treatments. Semiochemicals can be either allelochemicals or pheromones, depending on whether the interactions are interspecific or intraspecific. Pheromones are perhaps the most widely exploited semiochemicals at present, but recent efforts are also directed at identification and use of compounds involved in interspecific interaction as well, especially other behavior-modifying semiochemicals like host plant volatiles (which work either as attractants or repellants). Enormous work is involved in developing an efficient system, which involves identifying and optimizing pheromone blends, best dispenser dosages and fine-tuning trap designs to ensure that they are highly species-specific and optimally attractive to the target species.

The pheromones have been widely used for monitoring adult populations of endemic pest species, detection and survey programs for invasive species, mating disruption, and mass trapping of target species. The technique of mass trapping using pheromones has become a highly effective, environment-friendly and relatively inexpensive means of suppressing populations of those pest species whose pheromone communication systems and bionomical characteristics make them susceptible to this approach. In this technique, traps are deployed at optimum densities that have proven to attract and capture sufficiently large numbers of insects ensuring direct reduction in damage to the crop. In coconut IPM, the basic strategy employed is mass trapping of adult insects using pheromones. There are several reports of highly successful and effective commercial mass-trapping programmes being executed against weevil pests of coconut and other palm species like oil palm, especially the American palm weevil (Rhynchophoruspalmarum), a highly damaging pest of oil and coconut palms in Central and South America, red palm weevil (R. ferrugineus) infesting oil palm and coconut in the Middle East and coconut rhinoceros beetle (Oryctes rhinoceros) in the Middle East.

Because of the complex biological activity of semiochemicals, their dispersion in the ecosystem need to be regulated carefully, which warrants development of slow-release devices ensuring a controlled release of these biologically active volatile compounds, from both biological and economic considerations. In India, aggregation pheromone (4 methyl 5 nonanol +4 methyl 5 nonanone 9:1) is used in tandem with food baits to attract the red palm weevils. Though effective, these lures need to be replaced once in 3-4 months. Nanoporous materials are a novel carrier/ dispenser for the volatile signaling molecules with controlled spatiotemporal release rates. A nano-dispenser, with ordered pore channels, has been developed for loading the pheromone and kairomone blends of red palm weevil, ensuring a delayed dissipation (as confirmed by Field Scanning Electron Microscopy (FESEM), X-ray Diffraction (XRD) and Thermal Gravity Analysis) and consequently longer life in the field.

CPCRI has recently successfully characterized the

Cocosap chiller to collect Kalaparasa

kairomones (allelochemicals emitted from the host attracting the insects towards it) from host volatiles, which can act as pheromone synergists in red palm weevil management.Placing of food baits (fermenting banana, pineapple and neera) with the commercially available pheromone lure in the conventional bucket trap was found to have synergistic effect in attracting the red palm weevils. It was then reasoned that, if the volatiles released from these food baits are identified, it can facilitate development of efficient kairomones that could be used in tandem with pheromone, rather than the fresh food baits. Through concerted efforts over a considerable period of time, the physiologically relevant volatiles from the food baits were identified by combing with chemical and biological detectors, followed by wind tunnel behavioural assay. Thus, a 'kairomone blend' (having major and minor components) along with the pheromone (4 methyl 5 nonanol + 4 methyl 5 nonanone 9:1) was found to induce maximum activation. The next step was stringent evaluation of its field efficacy. Field evaluation at several locations across the major coconut tracts in India showed excellent results, with the pheromone loaded in nanomatrix combined with a kairomone blend' trapping higher number of weevils than the reference commercial lure (alone), thus ensuring better efficiency and better cost-effectiveness besides making it very user-friendly in the field.

Value addition: The need of the hour

Traditionally, the share of value added products from coconut (apart from coir and coir based products) in the Indian export basket is very negligible. The silver lining is that the situation has started changing over the last few years. It is really heartening that the export of coconut products (except coir and coir products) during 2014-2015 rose by 13.5 per cent to Rs.1,312.38 crore, against Rs.1,156.12 crore during 2013-2014. The most notable thing is that the export earnings from coconut shell-activated carbon alone was Rs.588 crore and virgin coconut oil recorded a significant increase (in both quantity and value) to reach Rs.24.72 crore, up from Rs.4.81 crore during 2013-14. This encouraging trend continued in 2015-16 also, fetching a record Rs. 1,450 crore, an increase of 10.50 per cent over the previous financial year. This achievement is all the more creditable in the backdrop of the overall picture of merchandise export from India showing a negative growth. However, a disturbing reading amidst this happy tidings is the reports that "in spite of the high demand for organic virgin coconut oil, the order for exports could not be met due to limited production of certified organic virgin coconut oil", a food for thought for all the concerned.

Evidently, there is no room for complacency, as there are plenty of opportunities still to be exploited. An exemplary case is that of Sri Lanka, which is a major exporter of value added products, though not a major producer of coconut. It may seem unbelievable that coir pith (a refuse from coconut fibre industry) from Sri Lanka is in great demand in USA, Europe and Australia, as an important ingredient of soilless potting media. Juxtaposed with this is the all too familiar sight in the west coast of India, especially in the coastal Kerala, where one can see heaps of coir pith, often rising to the heights of small hillocks, dumped in the premises of fibre extracting units.

Neera (Kalparasa), the nutritious health drink from coconut inflorescence, is actually the phloem sap rich in sugars, protein, minerals, anti-oxidants and vitamins and is literally the 'health and wellness capsule' in every drop. Moreover, the glycemic index (rate at which sugar is absorbed in blood) is found to be low in neera. The fresh sap has a very good colour like honey and it is sweet and delicious. Neera is virtually the game changer for the coconut farmers faced with low profitability, consequent on high cost of cultivation and lower prices for the traditional products (copra/oil) coupled with the market uncertainties. Even by conservative estimates, it has been demonstrated that a farmer tapping 15 coconut palms for neera could earn on an average net profit of Rs 45,000 a month, while a tapper can earn about Rs 20,000 per month.

Realizing its huge potential, the Institute has developed a simple ice box technology (Cocosap chiller) to collect farm-fresh, hygienic, unfermented sap from coconut palm, totally free from contamination with insect, ants, pollen and dust particles. The sap, thus, collected under cold condition remains fresh and unfermented, and can be stored for any length of time

under refrigerated conditions. The sap, thus, obtained can straight away be consumed as ready-to-serve drink or can be used for the preparation of natural sugar, jaggery, honey or other value added products without the addition of any chemicals, for which technologies are also developed. Besides, a bottling technology has been developed for neera to extend its shelf-life up to 45 days under refrigerated condition without adding any preservatives and additives. Coconut sugar based products such as Kalpabar , a dark chocolates and Kalpa drinking chocolates in collaboration with CAMPCO and various other value added products include, extruded product (Kalpakrunch), ice creams, chips and neera based sweets were developed.

Empowering the Value Chain in Coconut

To strengthen the value chain involving production, community level processing of coconut, and marketing, a consortium of three research institutions viz., Central Plantation Crops Research Institute, Kasaragod, Kerala Forest Research Institute (KFRI), Peechi, and Defence Food Research Laboratory (DFRL), Mysore was formed under the proposed project.

Effective linkages were established with agencies such as Coconut Development Board, State Department of Agriculture, and women SHGs to implement the project. In the upstream end of the value chain Community Based Organizations (CBOs) were formed in selected Panchayats to overcome the structural rigidities of coconut homesteads for adopting production technologies. The CBOs formed were further strengthened with sustained provision of technological and knowledge inputs. Participatory assessment of coconut farming scenario in all the selected clusters was carried out. Prior to implementing, project sensitization meetings were conducted in the clusters to create awareness on the project objectives, activities, plan and mode of operation. Various interventions related to productivity enhancement as well as product diversification proposed under the project were discussed in detail. Based on the area under coconut, dependence of coconut farming as the main source of income, willingness for implementing the proposed intervention, proximity etc. farmers were selected. Clusters were formed by conducting a reconnaissance survey by the experts along with the Grama Panchayat. Community Based Organizations (CBOs) of coconut farmers were formed in the identified clusters for easy implementation of the interventions.

The baseline survey, prior to implementation, indicated that agriculture was the prime occupation of the farmers in two-third of the holdings selected. More than 65% farmers were having 20 or more years of experience in farming and the holdings selected were predominantly garden lands and coconut was the prime cultivated crop.

Value added products like sugar, virgin coconut oil, chips, extruded products, chocolates

However the level of adoption of improved production and processing technologies including plant protection was found to be very low indicating the need for suitable interventions.

Coconut basin management with leguminous creepers, inter/mixed cropping in coconut gardens, integrated nutrient management, integrated pest and disease management, soil and water conservation measures and organic recycling through vermicomposting were the interventions introduced to enhance productivity and profitability and higher resource use efficiency. The average yield of coconut in the selected gardens prior to the implementation of the project was 62 nuts/palm (in the year 2007-08). After three years of implementation of the project, the coconut yield was increased to 112 nuts/palm which was 80% more than the yield reported during the base line survey. The increase in yield was mainly due to the agro techniques implemented in the gardens.

In order to overcome the problems encountered by farmers in harvesting coconut, climbing devices were popularized. The available devices were evaluated for technical merits, user friendliness by taking in to account the perspectives of skilled labourers on the use of such devices and it was found that the 'Chemberi Model climbing device' was more efficient than other models and so four machines of this model were supplied to each

cluster for timely harvesting of coconut.

An array of high value added products were developed through the project viz., Virgin Coconut Oil (VCO), Coconut Chips, Coconut Vinegar and VCO meal based confectioneries . An activated carbon plant was designed for the production of pollution free coconut shell charcoal for community level processing at small scale level. This is indeed a breakthrough output of the project. With regard to the commercialization of technologies the project could successfully develop market for the value added products through well established link with the retail distributor. Moreover, the marketing functionary was made a part of the value chain through appropriate integration techniques adopted and there by ensured the efficient functioning of the chain.

Women Self Help Groups (SHG's) were formed to produce value added coconut products. Technical know-how including hands on training was given to them on production of coconut chips and virgin coconut oil (VCO) from coconut kernel, vinegar from coconut water, and VCO meal based confectionaries. Incubation support was given whenever required, especially at the beginning to start such coconut based enterprises. Apart from technical aspects, good practices of food processing, attractive packaging with information desired by the consumers, quality control, procurement plan of raw material, pricing, and marketing were also taught to these SHGs. The processing units procured the required raw material (coconuts) produced by the CBOs to prepare value added products and marketed either directly or through other marketing agencies. The net result of these interventions was observed as gaining more income to the farmers, employment generation to women folk and creation of entrepreneurship among the farmers. On seeing the success of these farmers, many neighboring groups of farmers have taken up these technologies for implementing in their field.

Community adoption of technologies through farmers participatory approach, biological control of leaf eating caterpillar near Udupi, Karanataka,

Harnessing the synergy from linkages and collaborations

Right from the beginning, there were conscious efforts at fostering linkages and enlisting partnerships in collaborative research programmes, both at national and international levels. At the national level, work on electron microscopy for the investigation on etiology and remote sensing technique using infra-red aerial photography for diagnosing root (wilt) disease in early stage were in progress in collaboration with IARI and ISRO. A project on agrostology and mixed farming was initiated in collaboration with the Indo-Swiss Project at Mattupatty and the Intensive Cattle Development Project, Kerala.

As early as 1970, international level investigations on bud rot of coconut were in progress with USAID under the PL-480 programme. Collaboration with the Common wealth Institute of Biological Control (presently ICAR-NBAIIR), Bangalore was facilitated for work on biological control of mites. Another area in which the institute was making concerted efforts to obtain collaborative support for the ongoing research programme was the root (wilt) disease. There were four consultancy visits from overseas,by Dr FO Holmes (Rockefeller Institute, New York) in1964, Dr B Weischer (University of Munster, West Germany) in 1966 - 1967, Dr JW Randles (University of Adelaide, South Australia) and Dr DJ Raski (University of California, Davis) in 1979 to study the problem.As part of the Indo-UK protocol signed in 1977-78 under the Natural Resources Development Programme, the CPCRI was identified to partner with Rothamsted Experimental Station, the biggest and the most prestigious agricultural research station in UK, for taking up co-operative research programmes on root (wilt) disease of coconut and yellow leaf disease of arecanut

International collaborations with BIOVERSITY/ COGENT/APCC in coconut research and development was further strengthened in the 1990's with several IFAD/DFID/COGENT funded projects taking off.A total of 20 projects were undertaken by the Central Plantation

Crops Research Institute (CPCRI). Funding support for coconut PGR-related projects amounted to a total of US$ 392,600 out of which US$ 215,975 was provided by ADB, APCC, DFID and IFAD, while US$ 176,625 came from counterpart financing by ICAR. Under this initiative, several meetings/conferences/workshops were held in India from 1995 to 2005, with CPCRI hosting the 4th COGENT Steering Committee Meeting and CGRNAP Annual Review and Planning Meeting in 1995 at Kasaragod and the 14th COGENT Steering Committee Meeting in 2005 at Mangalore.

The International Coconut Gene Bank for South Asia (ICG-SA), one among the five multi-site genebanks established by FAO/Bioversity-COGENT to promote conservation as well as exchange of coconut germplasm for the benefit of the coconut community, was established under a tripartite agreement among ICAR-FAO-ITPGRFA. Planting of coconut accessions in the ICG-SA, located at CPCRI Research Centre, Kidu, Karnataka, was initiated in 1998. In the initial years, Indian coconut germplasm was regenerated and planted in the Gene Bank. Subsequently, the genetic base of the ICG-SA was broadened with the introduction of exotic coconut germplasm. A total of 91 accessions have been planted over the years in the ICG-SA, representing coconut germplasm from the host country (India) as well as coconut ecotypes collected through COGENT-ADB from Sri Lanka, Bangladesh, Indian Ocean Islands of Mauritius, Madagascar, Seychelles, Comoros, Reunion and the Maldives.This genebank is the treasure house of genetic diversity to combat the immediate challenges of the present and the emerging exigencies of changing climate.

Participatory and co-learning approaches in extension

With the passage of time, the dreary 'preaching, teaching and monologues' have given way to more meaningful 'dialogue and engagement' with the stakeholders. This shift from the conventional 'transfer of technology' model to participatory co-learning and decision-making support could improve the extension service delivery and serve as an important strategy for the extension machinery to engage a broader client constituency. Two landmark advances in this approach were the evolving of a technology delivery mechanism for area wide community adoption of technologies (like IPM of rhinoceros beetle and red palm weevil in coconut) and developing methodologies for assessing and enhancing of group performance and group capacity of community based organizations in coconut sector. Assessment and refinement of technologies are done with the active participation of farmers, by organizing various programmes with the cooperation of developmental departments/ commodity boards. Thus, research and extension activities have been fine tuned considering the demand of the stakeholders.

Steering the coconut development: The Coconut Development Board

Developmental activities for coconut in India are mainly taken up through the department of agriculture and the Coconut Development Board. The main objectives of the schemes taken up by the department are to facilitate the adoption of economically viable farming system and to maximize productivity of coconuts through cut and removal of old and senile palms, replanting with disease tolerant seedlings, scientific management of the existing coconut gardens and providing irrigation facilities. Apart from this, augmenting production of planting materials through departmental farms, coconut crop insurance and other schemes through Rashtriya Krishi Vikas Yojana are being implemented by the department. The Central schemes implemented by the department are the production of T x D hybrid seedlings and establishment of regional nurseries as well as national project on organic farming and CDBs scheme for integrated farming in coconut holdings for productivity improvement.

Coconut Development Board under the Ministry of Agriculture was established in 1981 with its headquarters in Kochi for the development of coconut cultivation and allied industries. The Board commenced implementing developmental programmes from 1982-83 which was the third year of the Sixth Five Year Plan Period. Programmes triggering the production, processing and

Area wide bio-management of rhinoceros beetle through farmer participatory approach at Bharnikavupanchyat, Kerala

Friends of Coconut Tree, woman empowerment

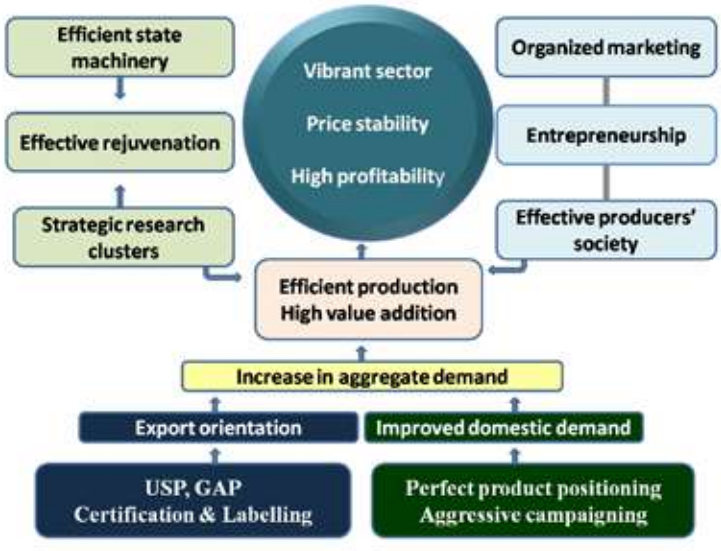
export were effectively implemented through schemes viz; production and distribution of planting material with emphasis on dwarf and hybrids, expansion of area under cultivation, integrated farming for productivity improvement, technology demonstration, coconut palm insurance scheme, and replanting and rejuvenation of coconut gardens. Realizing the importance of production and distribution of planting material, the Board has implemented various programmes, including production and distribution of hybrids and other improved varieties through state departments, establishment of regional coconut nurseries and assistance for establishment of nucleus seed gardens/ nurseries. Considering the importance of identifying suitable varieties and enhancing the production of seedlings, demonstration-cum-seed production farms were established in different agro climatic region of the country.

The Govt. of India sanctioned the Central Sector Scheme "Technology Mission on Coconut" (TMOC) during January 2002 to provide technical support, evaluation and emergent requirement, management of insect pest and diseases as well as processing for value addition and product diversification. The new initiatives of the Board include enhancing the productivity and income from unit area of coconut holdings through cluster approach, rejuvenation and replanting in coconut gardens, creation of skilled labour bank through "Friends of Coconut Tree" programme etc. Welfare schemes like coconut palm insurance scheme and "KeraSuraksha" insurance scheme for coconut tree climbers are also implemented by CDB.

Recently the Board has initiated formation of Coconut Producer Societies (CPS) by mobilization of small and marginal coconut farmers in a contiguous area and their federated forms of Coconut Producers Federation (CPF) and Coconut Producers Company aimed at socio economic upliftment of the farmers through productivity improvement, cost reduction, efficient collective marketing and processing and product diversification. At present, 65 Coconut Producer Companies have been formed around the country.

The road map for a vibrant coconut sector

The immediate priorities for improving the coconut production is the massive removal of senile and disease affected coconut palms which are beyond recovery, regulating the palm density, and replanting with high yielding planting materials along with adoption of suitable agro-management practices in farmer participatory cluster mode. It is of paramount importance to develop an exclusive policy for production and supply of elite planting materials to the farmer. Further, to increase the quality seedling production in coconut, it is necessary to develop coconut seed gardens in a Private Public Partnership (PPP) mode so that the enhanced seedling production to the tune of 50% of the expected demand can be assigned to Coconut Producers Societies, accredited Coconut Nurseries and NGO's, through a decentralized seedling production programme which would thereby effectively complement the quality



Restructured innovation system of coconut sector for a vibrant coconut economy

planting material production from the government sector. Moreover, since most of the existing seed gardens have been established more than 25 years back, the existing mother palms (especially dwarfs) in such seed gardens are nearing senility. Hence, urgent action should be initiated for replanting such seed gardens with parental lines of new and improved varieties recommended for the respective regions. Further, to increase the capacity for hybrid seedling production, a decentralized production mechanism is to be envisaged by maintaining a centralized pollen storage and supply mechanism.

It is also essential to develop a system of mandatory accreditation of all coconut nurseries. Meanwhile, sale of coconut planting materials from other non-recognized agencies should necessarily be banned to prevent sale of spurious planting materials. This is of greater significance in plantation crops like coconut, since there is a long juvenile phase and the genetic potential of the palm will be visualized only after a few years of planting, and use of inferior palms for planting would result in huge loss to the growers in terms of production capability and input-use efficiency.

Rainfed cultivation of coconut is one of the major reasons for low productivity. The water scarcity being experienced by the palms during December to May months causes reduction of yield during the lean periods. Irrigating coconut palms wherever possible could be adopted. The drip irrigation system along with fertigation is found to be the best suited with maximum water saving and fertilizer use efficiency. There is need to provide assistance to the coconut sector for large scale adoption of this technology.

Massive campaigns for on farm organic matter recycling, identification and effective management of pests and diseases (especially red palm weevil and bud rot) in decentralized (panchayat level) mode are necessary. Crop surveillance and timely forecast of disease incidence should be carried out by the research and development agencies in endemic areas. Capacity building programmes for the benefit of small and marginal farmers on identification/understanding of field problems and adopting solutions is also essential. Besides, strengthening and popularization of systematic coconut based farming system as a strategy to make coconut farming economically viable in small holdings need to be highlighted. Financial assistance extended under NHM as well as other state schemes can be made available to the farmers for adopting coconut based farming system.

It has been indubitably proved that a large number of value added products could be made from coconut meat, water, shell, coir pith through composting etc. Therefore, promotion of farm level and community level processing of diversified products and byproducts obtained from coconut palm are highly imperative. Tender coconut marketing is one of the profitable activities which need to be promoted in the state. Farmer's collectives as well as enterprising youths are to be supported in organizing marketing outlets in potential areas for tender coconut. This not only helps to improve the farm level economy of farmers, but also create opportunities for employment to the rural youth in the country.

Kalaparasa outlets

Another strategic area yet to be utilized in the state is production of neera and palm sugar. Technologies are now available for preserving and packing coconut sap as 'neera 'or sweet toddy as non-alcoholic health drink. The Government of Kerala has issued license to various Farmer Producer Organizations on a pilot scale in all the districts of Kerala to produce, process and market neera and Karnataka is a follower in this regard. The CPCRI technology for the collection of inflorescence sap (Kalparasa) is very hygienic and contamination free. Various value added products like coconut palm sugar, palm jaggery, coconut honey and coconut syrup can be made from neera. If effectively utilized, tender coconut and neera, are capable of helping the farmers to cope up with the price instability in coconut. Therefore it is essential to encourage farmers' organizations to produce various value added products from neera in attractive packing and exploit the domestic and international markets.

Encouraging more entrepreneurs in coconut sector by establishing 'Coconut Parks' by state governments for organized processing for value addition will help coconut farmers to de-link the over dependence on coconut oil in determining coconut price. To begin with, Coconut Parks may be set up in districts with an area more than 20,000 ha under coconut cultivation.

Unilateral increase in production alone will not help the sustenance and stability of the sector. The growth of production must be supplemented with guaranteed procurement and remunerative price for the farmers. In order to create an impact in the market and for the benefits of MSP to reach the genuine coconut farmers, adequate quantity of copra should be procured. The studies on pattern of distribution of annual yield of coconut indicates that the number of nuts harvested, varied from harvest to harvest, and 60% of the production of a coconut palm is harvested during the peak production period i.e., the first six months of the calendar year, and hence a stable price during these periods is utmost important. The copra procurement scheme should be designed keeping view of this important aspect of coconut production. Along with this, making available skilled climbers for undertaking timely plant protection operations as well as harvesting is another serious concern. Therefore, stakeholders must contemplate on this issue to come up with a sustaining labour bank for coconut climbing and related operations.

Participatory research involving farmer groups for refining and fine tuning of technologies for higher efficiency of the sector is to be given greater emphasis. Farmer organizations are to be facilitated for meaningful partnership in technology generation and transfer for achieving efficiency in coconut commodity chain. Integrating youth/women farmers organizations with other main stream groups in agriculture with leadership roles and mainstreaming functions should be supported with policy prioritizing, for empowerment of the target groups and sustained development of the coconut sector.

Summing Up

The current sectoral innovation system of coconuts in the country has huge strengths on the research front of coconut, but the lack of price stability, inadequate price support mechanism and marketing facilitation are the factors detrimental to the functioning of coconut value chain in the state. The lack of effective group coherence among different stakeholders is still remaining as a problematic facet. The Institutes should take a lead role to re-engineer and revitalize the coconut sector in the state by providing adequate emphasis on product diversification and creation of neo-market platform to promote coconut as a high nutrient value product.

With the growing realization of lesser profitability in small farm holdings, producers/farmers should be encouraged to get together and form into small cooperatives or crop based organizations to develop and utilize community facilities for farm operations, post harvest processing and marketing to economize on production as well as marketing costs. For the vision of developing a sturdy and vibrant coconut industry which does not depend on copra/oil to come true, we need to come up with breakthrough coconut products which

Agribusiness planning centre at CPCRI for value addition in coconut.

are strong enough to capture the niche export market segment. As the technologies are adopted only when profitable, policy interventions in market and regulation of trade tariffs to the benefit of the industry to compete with global players are the way forward. To encourage investments in the coconut sector, the government, as matter of policy, must consider coconut as a priority crop in its national agricultural development agenda. The government and private financial sector through the banking system should provide support through reasonable credit schemes for coconut processing business ventures.

At present, the ambience of coconut sector in the domestic arena is positive wherein the horizontal node of the value chain aspect is strengthened by the formation of Coconut Producer's Society at the grass root level to Producer's Company at the highest level. Thereby provides an excellent auxiliary support for the ambitious export orientation programmes. The strategic positioning of developmental and research support (CDB, CPCRI, KAU, NAFED) is another very important factor which will provide the much needed impetus for the sectoral development. Moreover, Indian export sector has become vibrant with very high growth rate since CDB has upgraded to the status of Export Promotion Council (EPC).We may also develop an organic coconut supply chain targeting the niche high priced outward markets in the world. It is certain that in the near future, together we may create a vibrant, equitable and sustainable coconut sector through innovative and inclusive programmes and policies that contribute towards prosperity of all stakeholders of coconut. ■

Future Research for Coconut as a Sunrise Industry

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Background

Coconut is a crop of the small holder farmers of the tropical countries. Though coconut is classified as an oilseed crop, it is an integral part of the daily life of the farmers for food, fuel and shelter thus contribute largely to the social well being of rural communities. It is a crop with multifaceted uses, known to mankind for generations through traditional knowledge and is rightly referred to as the Tree of Life. Research in coconut has been undertaken both by the coconut growing and importing countries for over a century. As agriculture sector evolves from subsistence farming to commercial production, the research objectives are also varying to be not just about increasing production or productivity but oriented to cater to the requirements of the consumer markets.

The recently concluded 47th APCC COCOTECH Conference was witness to various innovations in coconut research. The Conference also served as an eye opener towards the "half full and half empty" situation in coconut research, especially in scientifically proving the nutrition and health benefits of coconut. The deliberations and discussions not only gave an indicative direction for the future road map in coconut research but also succeeded in collaborations and networking of scientists from various countries, for the sustainable development of the coconut sector to benefit millions of small holder coconut farmers around the world.

Research for Production

Research on coconut breeding has taken a major step from the normal breeding for high productivity and disease resistance to breeding for higher content of oil, lauric acid, protein in the meat, inflorescence sap and tolerance to drought as well as shorter statures.

With over 50% of the coconut plantation in the major coconut growing countries approaching senility, the urgent need is the requirement for planting materials which can be materialsed only through use of modern technological applications. Biotechnological research should be intensified along the lines of embryo culture,

cryopreservation and somatic embryogenesis. Research on embryo culture will help in the production of high value elite coconuts like Kopyor, Makapuno, Aromatic Coconut and similar which are in high demand and not easily propagated otherwise. Cryopreservation gains importance as a potential mode for preservation of the coconut germplasm, when gene banks are under threat of climatic disasters and lethal diseases. Also cryopreservation would be useful in transfer of germplasm between countries and help in biosecurity. The research on cryopreservation has to go a long way with regard to survival and recovery. Research on micropropagation techniques based on somatic embryogenesis for mass production of planting materials is gaining momentum in most of the coconut growing countries. Though research using explants like embryo, pollen, unfertilised ovaries, plumules etc have been tried in many countries, Mexico has been successful in achieving the break through in somatic embryogeneisis through development of protocol using plumules as explant and successfully producing around 100,000 somatic embryos from a single plumule. Major challenges in somatic embryogenesis experienced by researchers are issues of tissue browning, inefficient proliferation and low regeneration which have to be addressed. The recent Bali Conference provided a forum for the networking of scientists engaged in tissue culture work, which would be developed to an International Network or Forum for Coconut Tissue Culture. This would foster collaboration between institutes and scientists thus avoiding duplication of research, hence better integrate various research work undertaken by different countries. The successful testing of proven protocols on different genotypes could also be achieved through proactive efforts in networking and collaboration.

With diminishing trend in the natural resources such as land, nutrients and water available for crop production, research on the optimum use of the available resources through engineering structures that will ensure provision of the resource at the feeder point gains importance. The technologies for drip irrigation and fertigation continue to be improved to ensure maximum benefit with minimal investment.

Research for Plant Protection

Effective management of the incidence and threats of pests and diseases necessitates collaborative research for the development of international phytosanitary standards, risk analysis, diagnostic tools, identification and development of synthetic pheromones, bio-control agents and so on. At the Bali Conference a consultative meeting for the formation of a network of scientists engaged in Integrated Pest Management was organised which would lead to the establishment of the International Coconut IPM Network, as a result of a

recommendation of the FAO Report. (The Report of the FAO High Level Expert Consultation on Coconut Sector Development in Asia and the Pacific has recommended to "Establish an Integrated Pest Management (IPM) Network for Coconut Pests and Diseases and design and implement a programme for transfer of technology on IPM of coconut pests and diseases"). Networking would help IPM and biosecurity planning. Natural enemies of invasive pests could be located only in the country of origin and countries could collaborate in this regard.

With the increasing incidence of devastating phytoplasma diseases like Lethal Yellowing and Bogia Disease, research on development of diagnostic tools like Loop Mediated Isothermal Amplification (LAMP) for the detection and tracking of phytoplasma DNA in plants and insects, remote sensing for identifying symptomatic palms and other biotechnological tools help in cheaper and easier tracking of the phytoplasmas which are crucial to contain the spread and manage the disease. An emerging area of interest in research is phytoplasmology dealing with study of endophytic organisms like fungi and bacteria and their interactions with plants. Reports of spontaneous remission or recovery of plants from phytoplasma infection incraese the importance of phytoplasmology.

Another priority area is study on the changes in expression of resistance to pests and diseases in cultivars having temperature sensitive genes, an impact of climate change. Changes in expression of different genes is expected to occur with the devastating and diverse impacts of climate change. Higher temperatures are found to reduce the period for reproductive maturity thereby increasing the reproduction rates. Genomic studies on host plant resistance to pests and diseases is

also an important area for further research.

Research for Downstream Processing

Research in innovative technology for processing, integration of different processing technologies, packaging to improve shelf life and efficient utilisation of by-products are very important to the profitability of enterprises. The hybrid system of virgin coconut oil processing presented during the COCOTECH Conference aims to utilise the correct technology to obtain the right quality so that the products attain competitive prices on the existing markets.

Research should also identify the specific differences in qualitative parameters in the final product based on the technology used or type of raw material. This is particularly significant in the case of virgin coconut oil where various technologies are used for production, it results in the brand label that carry different wordings of product type such as Extra Virgin Coconut Oil, Virgin Coconut Oil, Pure Coconut Oil, Cold Pressed Oil and so on. The consumer should be able to know the content of the product by its label. In a similar case, the changes in qualitative parameters between beverages, whether using young coconut water or mature coconut water holds significance in the global market since water from the mature coconut is just as good a beverage with most of same nutritional attributes.

Research for Health Benefits

There is a dearth of validated research to support the claims for coconut products. A comparative analysis of clinical studies conducted reveals that over 256 clinical studies were done on olive oil, but only 36 conducted for coconut oil (including virgin coconut oil). It is crucial now for conclusive studies to be conducted to establish uncontestible scientific evidence. APCC has since established a Scientific Advisory Committee on Health (SACH) that is made up of eminent international clinical scientists from India, Indonesia, Philippines, Sri Lanka and the Pacific. Current Study proposals under discussion are :

1. A Randomised Controlled Investigator Blind Dietary Study to compare Virgin Coconut and Corn Oil Effects on Inflammation in Psoriasis and its Co-morbidities, Arthritis, Depression, Diabetes, Heart Disease, Hyper tension and Obesity. The study is led by Dr. Vermen M. Verallo-Rowell who is CEO and founder of VMV Skin Research Centre and Clinics in the Philippines.

2. A prospective, randomized, parallel group study in normal healthy adults to assess the cardiovascular endpoints like myocardial infarction, death, stroke as primary end points and assessment of lipid related biochemical parameters as secondary endpoints that is led by Dr. M. Vijayakumar of Amrita Institute of Medical Sciences in Kochi, India.

3. Effect of Virgin Coconut Oil on HIV positive people by Dr. Kadek Dharma Widhiarta of the University of Jember in Indonesia.

4. Effect of Virgin Coconut Oil on Fasting Serum Glucose, Insulin, Ketone and Tri-glyceride concentrations among Indonesian non-insulin dependent diabetics by Dr. Drupadi HS Dhillon of the University of Indonesia in Jakarta, Indonesia.

Research for By-Product Utilisation

Research on the utilisation of the coconut timber is a priority area with many countries implementing programmes for replacement of senile coconut palms. Commercial technology is to be developed for the large scale utilisation of coconut wood. Technology for utilisation of coconut husk for various products like coconut fibre, coco peat and crushed husk for grow slabs has ample room for improvement. With increasing applications in geotextiles, horticulture and floriculture, there is immense potential for coco fibre, coco peat and the crushed husk.

Research is continuous, often used to establish facts, reaffirm the results of previous work, solve new or existing problems or create, innovate and make for the benefit of future generations. In the coconut sector, as the environment changes, new problems arise in production and plant protection for which solutions are needed. As civilization progresses, their needs and demands for products changes. As science progresses, technological advancements also follow hence the innovative methods of processing and packaging. There never reaches a point where we are self sufficient. For the coconut sector to experience real inclusive growth and sustainability, it needs scientific research that is geared for development, impacting in real time positively for the coconut farming families and the global coconut community. ■

CDB marches ahead to meet client needs

R Jnanadevan, Deputy Director, CDB, Kochi-11

Introduction

The current Indian coconut scenario presents a highly encouraging picture, by becoming the largest producer of coconut having 31% of total production in the world and number one position in productivity among member countries of the Asian and Pacific Coconut Community (APCC). Coconut is cultivated in 16 states and 4 Union Territories in the country. Widely acclaimed as Kalpavriksha or Heavenly tree, the coconut palm provides food security and livelihood opportunity to more than 20 million people across the globe and 10 million people in India. World production of coconut as per APCC Statistical Year Book 2014 is 69,836.36 million nuts from an area of 12.20 million ha. As per 2014 world statistics, India is the largest coconut producing country in the world, contributing to 31.02% of the world production. India, Indonesia and Philippines are the leading coconut growing countries having 75.87 % of the total area under coconut and contribute 75.48 % of the coconut production in the world. Among the three major coconut growing countries, India stands at first position in productivity.

In India, the major coconut growing states are Kerala, Tamil Nadu, Karnataka and Andhra Pradesh. These four states together account for more than 90.11% of the coconut production in the country. Coconut has also been introduced to non traditional areas in Bihar, Chattisgarh, North- Eastern states like Assam, Tripura, Meghalaya, Arunachal Pradesh, Nagaland and pockets of Gujarat and Maharashtra. Coconut cultivation in the

country has witnessed many ups and downs during the past few decades. Being a crop of greater significance in livelihood sustenance, poverty alleviation and income generation to sizeable segment of the rural population of the coconut growing countries and of India in particular, concerted efforts of all the agencies involved in research and development is needed for a better coconut sector to ensure the profitability of coconut farming on a sustainable basis.

History of Coconut Development in India

The Coconut Development Board was constituted as a statutory body by an Act of Parliament viz. Coconut Development Board Act (1979) for the integrated development of coconut industry. Formation of Coconut Development Board (CDB) in 1981 was a breakthrough in the history of coconut development in the country. Considerable improvement in expanding area under coconut and technology development for product development could be achieved through the development programmes of the Board implemented in the country. The growth of Coconut Sector in the country during the past three decades of the post CDB period can be classified under three distinct areas. Firstly it is expansion of area under coconut to the non traditional belts from the coastal areas of the country. Secondly, increasing production and productivity of coconut in the country. The decline in the consumption of coconut oil in both edible and non-edible sector has led to the development of broad based processing technologies for product diversification and by-product utilization and also to launch intensive campaign in favour of the edible use of coconut oil. Thirdly, the problem of low income from the coconut holdings due to price fluctuations, low value realization etc. The non competitive nature of the industry has necessitated the need for adoption of an integrated approach in the development of coconut cultivation and industry in the country.

Though coconut and its products have found extensive uses throughout the country, 90% of coconut production is from the four southern states, viz. Kerala, Tamil Nadu, Karnataka and Andhra Pradesh. States like Goa, Odisha, West Bengal and Assam also account for a sizeable area and production.

Kerala, a small state with 1.18 per cent of the total land area of the country, though accounted for 58 per cent in area under and 50 per cent in production of coconut in the country in the past has shown a progressive decline in the contribution in both production and area under the crop. However, the growing dimension of population warranted the need for enhancing the production of coconut in the state as well as in other states. After the establishment of the Board, various measures were initiated for the integrated development of coconut cultivation and industry in the state. Even though 20

per cent of the total cropped area in Kerala is under coconut and the crop is an important source of livelihood to both growers, traders and processors in small and micro sectors, the state is losing its share to other states. From the original level the share of Kerala in area and production of coconut has slumped to 33% and 24% respectively. Bulk of the coconut acreage in the state is now concentrated in low-land and mid-land regions. A massive under planting programme is essential to the state to rejuvenate the area and production of the crop in the state.

Area and production of coconut in the country has been increasing since the formation of the Board. Coconut cultivation in the country during 1960-61 was in an area of 7.17 lakh ha with a production of 4,639 million nuts and that at the time of setting up of the Coconut Development Board in 1981-82 was 10.91 lakh ha and 5,940 million nuts respectively. The compound growth rate in area and production of coconut during these periods was only 2.12 per cent and 1.24 per cent per annum respectively. Productivity of coconut declined considerably to 5,445 nuts per ha in 1981-82 from the level of 6,466 nuts per ha in 1960-61. Growth in the sector expressed a quantum jump after the formation of the Board. Area stagnated at around 10.91 lakh ha has reached the level of 19.76 lakh ha in 2014-15 and production increased from 5,940 million nuts to 20440 million nuts recording an annual compound growth rate of 1.87 % in area and 3.94 % in production.

Area, Production and Productivity of Coconut in India (2014-15)						
	States	Area "000" ha	% Share in Area	Production Million nuts	% Share in Production	Yield (Nuts /Ha)
1	Kerala	649.85	32.89%	4896.61	23.96%	7535
2	Karnataka	515.03	26.07%	5141.15	25.15%	9982
3	Tamil Nadu	465.11	23.54%	6917.46	33.84%	14873
4	Andhra Pradesh	105.99	5.36%	1463.56	7.16%	13808
5	Odisha	50.68	2.57%	324.89	1.59%	6411
6	Gujarat	31.63	1.60%	295.03	1.44%	9328
7	West Bengal	29.41	1.49%	372.23	1.82%	12657
8	Maharashtra	28.10	1.42%	187.44	0.92%	6670
9	Goa	25.79	1.31%	127.72	0.62%	4952
10	Andaman Nicobar	21.91	1.11%	129.77	0.63%	5923
11	Assam	21.14	1.07%	237.49	1.16%	11234
12	Bihar	14.90	0.75%	141.38	0.69%	9489
13	Tripura	6.93	0.35%	28.41	0.14%	4100
14	Lakshadweep	2.57	0.13%	70.91	0.35%	27591
15	Puducherry	1.88	0.10%	21.90	0.11%	11649
16	Chhattisgarh	1.71	0.09%	27.85	0.14%	16287
17	Telengana	1.69	0.09%	25.34	0.12%	14994
18	Nagaland	1.45	0.07%	16.32	0.08%	11255
19	Mizoram	0.04	0.00%	0.16	0.00%	4000
20	Daman & Diu	Neg		13.99	0.07%	
		1975.81	100.00%	20439.60	100.00%	10345
Source : Horticulture Division ,Government of India						

The productivity which recorded a negative growth during the pre CDB period had shown an encouraging trend during the post CDB period. The high dependence on copra-coconut oil centered industry has been dissolved and considerable progress is achieved in the field of product diversification and by-product utilization. Many technologies were developed by CDB in association with premier research institutions in the country.

Technologies developed for the manufacture of various products like coconut cream, spray dried coconut milk powder, packed and preserved tender coconut water, virgin coconut oil and by-products like coconut water based vinegar, industrial utilization of wood for the manufacture of particle boards etc. are the significant achievements of the Board. Thus CDB played a pivotal role in enhancing the production and productivity of coconut in the country besides bringing a structural change in the field of post harvest management. Four southern states viz., Kerala, Tamil Nadu, Karnataka and Andhra Pradesh are continuing to hold the hegemony in coconut acreage and production in India.

Analysis of Area, Production and Productivity of coconut in major coconut growing states

Kerala

The state accounts for 32.89% of coconut area in India with 6.50 lakh ha. Even though Kerala is having the largest percentage of area under coconut cultivation in the country for the year 2014-15, significant decrease in area is observed over the year. Area decreased by 18.44% compared to the previous year, the reasons attributed are shifting from coconut to other crops, pest and disease like Root wilt/ Bud Rot and utilization of agriculture land for commercial purpose. In order to enhance farmers income from coconut sector, productivity needs to be improved and also by ensuring steady and reasonable price to the produce.

During the year 2014-15, the coconut production was 4897 million nuts and production decreased by 17.95%

over the previous year mainly due to decrease in area under cultivation. The coconut production in Kerala shows a decreasing trend during the period from 2011-12 to 2014-15. Productivity of coconut in the state is slowly picking up from a drop in 2012-13.

Tamil Nadu

Tamil Nadu stands first in coconut production and third in area under coconut cultivation. State accounts for 23.54% of coconut area and 33.84% of coconut production at national level. Large coconut holdings, scientific management and plant protection, cultivation of hybrid/dwarf variety at a comparatively higher level and availability of land is boosting the crop in the State.

As per Statistics for 2014-15, Tamil Nadu is the largest coconut producing state in India. During the year 2014-15, the coconut production is 6917 million nuts.

Karnataka

Karnataka holds second position in area under coconut cultivation and accounts for 26.07% of coconut acreage at national level having 5.15 lakh ha. Compared to the previous year 2013-14, area under coconut cultivation marginally decreased by 0.4%. Over the year from 2012-13 to 2013-14, even though the area under the crop recorded an increase, production recorded a decrease of around 17% which was due to the after effect of severe draught prevalent in the State coupled with pest attack.

In the state of Karnataka coconut is the second largest and important horticultural crop. Coconut production for the year 2014-15 is 5141 million nuts and production increased by 1.9% when compared with previous year 2013-14. In general, over the years the area and production has been on an upward movement, except for the drought affected year 2013-14. The state production is picking up back to the level during 2011 to 2013.

Andhra Pradesh

In the state of Andhra Pradesh, area under coconut cultivation as well as production is decreasing over the years from 2011-12 to 2014-15. This decrease is the after effect of the cyclonic storms Phailin that hit Andhra coast on October 2013 and Hud hud Cyclone in October 2014. However, the State could manage in keeping the productivity at a higher level compared to national average by adopting scientific management practices and further because of the good irrigation facilities available coupled with the fact that the land especially in the delta region is highly fertile.

Other States

All other states together contribute 12.14% to the total area under coconut cultivation. The states of Gujarat and Chattisgarh shows a tremendous increase in the area in coconut cultivation over the years as a result of expansion of area under coconut promoted by the Board and extension of other schemes of the Board for scientific coconut cultivation and management to non traditional areas.

Policies and Programmes of the Board

In India, development programmes in coconut are mainly dealt through state level assisted programmes and by Coconut Development Board under the Union Ministry of Agriculture and Farmers Welfare. From 2012 – 14 onwards CDB programmes are merged with the Mission for Integrated Development of Horticulture in India (MIDH) and CDB was considered as national level agency for implementing various development programmes of coconut cultivation and industry in the country. Since then, development programmes are implemented directly by the Board through FPos and State Agriculture/Horticulture departments. The programmes undertaken for the benefit of farming community are listed below along with the overall growth of coconut sector.

Production and distribution of planting material

Establishment of Demonstration cum Seed Production (DSP) Farms in different parts of the country for creating infrastructure facilities for production of quality planting materials besides demonstrating and educating the scientific coconut cultivation and processing to various stake holders in those regions, establishment of Regional Coconut Nurseries for extending support to various participating States for strengthening the seedling production programme, distribution of hybrids/dwarf seedlings in Govt. sector, establishment of Nucleus Coconut Seed Garden and coconut Nurseries in private sector are taken up under this programme. Every year nearly 20 lakh seedlings were produced and distributed under these schemes. 10 DSP farms have so far been established in different parts of the country which not only serves as demonstration centre but act as a source of quality planting material to the farmers.

Expansion of Area under Coconut

This programme is to extend adequate technical and financial support to the farmers to take up coconut cultivation on scientific lines in potential areas to attain a significant achievement in the future production potential. Financial and technical assistance is extended under the scheme for taking up new planting of coconut in potential areas. 1.54 lakh ha was brought under coconut planting by extending financial assistance of Rs. 62.98 crores under the schemes of CDB.

Integrated Farming for Productivity Improvement

The objective of the programme is to improve production and productivity of the coconut holdings through an integrated approach and thereby increasing the net income from unit holdings. Laying out of Demonstration Plots of up to 1 ha size in farmers fields by providing all necessary inputs and establishing Organic Manure Units by providing incentives demonstrated the efficacy of scientific management of coconut palms and

coconut based farming system in an area of 3.15 lakhs ha by extending financial assistance of Rs. 298.47 crore under the scheme upto 2015-16.

Technology Demonstration/Quality testing lab

The country is confident and trying to come up to the forefront in value addition too. Technological upgradation / introduction of precise processing machineries and equipments for making quality products, international quality specification with proper packaging, labeling and branding are also in the agenda for realizing value for the processing sector both in domestic and international market. Indian coconut industry has already recorded a perceptible growth in production and productivity of coconut in the country. This achievement will be translated in terms of fair, remunerative and steady income to the producers which in turn will lead to the overall growth of the Indian coconut sector.

The CDB Institute of Technology (CIT) set up in Kerala is engaged in the development and demonstration of technologies for product diversification and by-product utilization of coconut. The centre is devoted to product development, microbial analysis of coconut based products apart from skill development programmes to interested entrepreneurs and self help groups for acquiring technologies on post harvest coconut processing and process demonstration. The Institute received the recognition of NABL. Many value added and novel products are developed by the institute during the recent years.

Marketing, market intelligent services, Statistics and Export Promotion Council

Under this scheme activities such as Market information and intelligence service, Modernization of coconut processing by the introduction of improved copra dryer/other processing machineries/equipment, Surveys and Evaluation Studies including concurrent estimation of coconut production and productivity, Export Promotion Council activities are undertaken.

Publicity and Extension activities

The Board is disseminating information on various aspects of coconut cultivation and industry through various media and publication besides organizing training programmes to impart skills and knowledge to farmers, unemployed youths and rural women in various fields related to coconut apart from participation in exhibitions and fairs under this programme.

Technology Mission on Coconut

The Technology Mission gives emphasis on the development of technologies for the management of insect pest and disease affected gardens and product diversification besides demonstration and promotion of these technologies for adoption. Under the Mission, research projects and clinical studies are sponsored through reputed institutions in the area of technology development and also to establish the medicinal and nutraceutical properties of coconut products especially coconut oil. So far 404 processing units have been established in various states across the country for the production of value added coconut products viz., desiccated coconut powder, virgin coconut oil, packed tender coconut water, activated carbon, shell charcoal etc. with a capacity to process 2247.19 million nuts/ year.

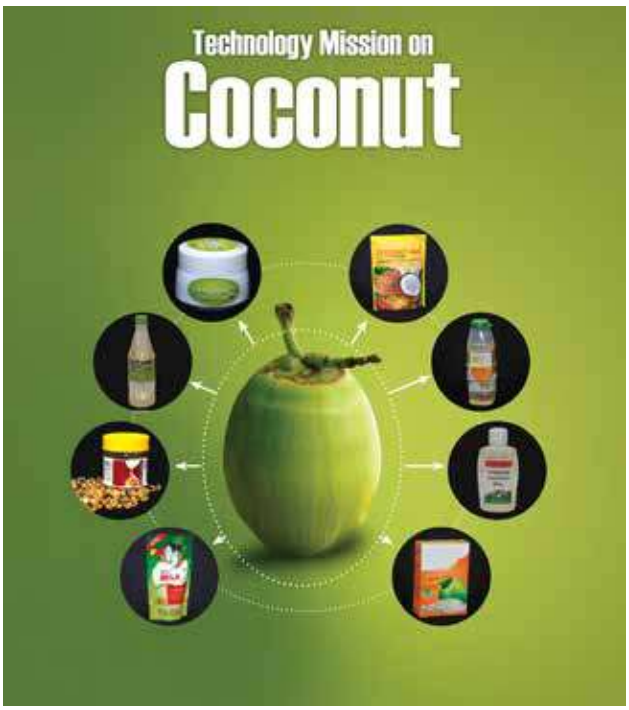
Replanting and Rejuvenation of Coconut Gardens.

Considering the emerging need, India has ventured into massive replanting and rejuvenation of coconut gardens in the traditional coconut growing states. Farmers are encouraged to cut and remove old, disease advanced and senile trees and replant with quality seedlings preferably with dwarf and hybrids. Remaining palms are scientifically managed. Technical and financial support is given to farmers for adopting scientific practices. To begin with, the programme was introduced in Kerala, the state with longest history of coconut cultivation where 1/3 rd of palm population was old, senile and disease advanced. Apart from the longest recorded history of coconut cultivation, the state is under the grip of a lethal disease called root wilt. Cutting and removing the disease advanced trees and giving management care to the existing palm population is the only strategy to manage the gardens. Therefore the R&R programme was implemented in the country from 2009 onwards and is continuing. The main objective of the scheme is to enhance the productivity and production of coconut by removal of disease advanced, old and senile palms, replanting with quality seedlings and rejuvenating the remaining palms by giving compensation to farmers for cutting and removal, replanting and rejuvenation.

During the last six years nearly 3.3 million disease advanced and senile palms were removed and replanted with quality seedlings. Critical inputs were also provided to the project area for adopting scientific management practices. Now the programme is being extending to other traditional states also. The efforts made under the scheme help to prevent spread of root wilt disease by removing 31.05 lakhs root wilt disease advanced palms and rejuvenated coconut plantations in 2.84 lakhs ha. is replaced with 8.57 lakhs seedlings.

Coconut Palm Insurance Scheme (CPIS)

Coconut Palm Insurance Scheme (CPIS), was implemented on pilot basis in selected coconut growing states in India from 2009-10. The objective of the scheme was to insure coconut palms against natural and other perils, which was implemented in association with Agriculture Insurance Company (AIC), in the participating states. CPIS scheme was modified and included as the third component of National Crop Insurance Programme (NCIP) from 2013-14 onwards.



A farmer with a minimum of five bearing palms in a contiguous area is eligible for insurance under the scheme. The premium towards insurance was shared in the ratio 50:25:25 between Coconut Development Board, State Governments and Farmers.

Kera Suraksha Insurance Scheme for Coconut Tree Climbers (CTC)

The 'Kera Suraksha' Insurance Scheme provides insurance coverage to the coconut tree climbers (CTC) @ Rs.2 lakh against 24 hours accident related risk including death. The annual premium of the policy is borne by the Board (75%) and the rest 25% by the beneficiary. The scheme is implemented in all coconut growing states.

Establishment of new Coconut Orchards

The objective of the scheme is to improve the production and productivity of coconut by establishing coconut orchards with high yielding varieties released by research institutes for different agro climatic conditions. The scheme is implemented in tribal areas through Farmer Producers Organization (FPO) in coconut growing states including scheduled and hilly areas

New policies and initiatives

Three tier Farmer Producer Organization (FPO) in coconut sector.

India has made a beginning in collectivization of coconut farmers. Coconut Development Board (CDB) has facilitated the formation of three tier Farmers Producers Organization (FPO) with Coconut Producers Societies (CPS) at primary level at the secondary level to Coconut Producers Federation (CPF) at intermediate level and Coconut Producer Company (CPC) at apex level. A company which is formed by 10,000 farmers will be producing around eight crore coconut from its jurisdiction. The main role of the Company is to establish processing unit for production of value added products from coconut procured from the member farmers. Such collectivization of farmers at grass root level facilitates collective farming practices, aggregation of farm produce, collective processing and marketing. The strategy has started yielding beneficial results in improving the management and in improving income of coconut farmers of the country. This would facilitate formation of Farmer Producer organizations, a new approach in coconut sector . So far 9292 CPS, 721 CPFs and 65 CPCs are formed in the country.

Skill Development Training Programmes (Friends of Coconut tree (FoCT)

Acute shortage of palm climbers to harvest and adopt plant protection measures is one of the problems faced by coconut growers. With a view to tackle this problem, the Board is conducting skill development programme from 2011-12 onwards, to train unemployed youths in developing special skills and confidence in coconut climbing and plant protection activities for the benefit of coconut farming community. The skill fetches the youth handsome income for their decent living and help to make available sufficient manpower to society in coconut climbing. It was due to the diminishing number of coconut climbers, the coconut cultivation left neglected and unattended. Around 50,000 trained skilled labours were created in this sector as 'Friends of Coconut Tree'. Friends of Coconut are trained for service to farming community. Active Friends of Coconut Tree fetch monthly income ranging from Indian Rs. 15,000 to Rs. 40,000 with an average earning of Rs. 22,000/- per month. This has evoked enthusiasm and encouragement among the farmers to bestow more attention to coconut.

Promotion of Neera production and marketing

Neera, the vascular sap from coconut inflorescence is one of the profitable value added products from coconut. Considering its nutritive value, health benefits and profitability its production is being encouraged by the major coconut growing states. Coconut Development Board has taken the initiative for developing a pool of Neera technicians. This is achieved in two phases, the first phase concentrating on moulding traditional toddy tappers into "Neera Master Technicians" through a training conducted at the CDB Institute of Technology (CIT) for a duration of two weeks. These master technicians in turn will train interested and eligible candidates at the respective Coconut Producer Company and Federation levels.

Products Development

India was lagging behind in technology development for product diversification till last two decades. Introduction of Technology Mission has given momentum to this area and now India possesses many technologies in value addition. Acceleration to the activities of CDB Institute of Technology, further quickened the process of product development. In the world, for the first time technology for processing and packing of neera and various downstream products like neera sugar, jaggery, honey etc have been developed. Food products like sweet/spicy chips, sweet chunks, chocolate, cookies, burfi, lemonade, flavoured juice, ice cream and milk spread are also the other very new additions of CIT's contribution in the product basket.

Conclusion

Indian coconut industry has recorded a perceptible increase in production and productivity of coconut in the country. This increase has to be translated in terms of fair and remunerative income to the producers. Now we should aim at a quantum jump in export and look forward to have bigger share in the international trade and make coconut one of the ten major agriculture commodities exported from India . It is also necessary to give utmost attention to quality assurance to Indian products to make them globally acceptable and to cost effectiveness to make it globally competitive. For achieving price stability and increased returns the strategy will be to divert at least 20-25 percentage of the total production of matured nuts for value added products other than copra and coconut oil. Thrust is also required for replanting and rejuvenation, promotion of early bearing and high yielding planting material of hybrids and other varieties, aggregation of small and marginal farmers, strengthening of farmer collectives and reducing dependency of coconut industry on copra and coconut oil by promoting farm level processing and marketing. Considering the diminishing market for traditional coconut products, R&D has to be guided towards production of more value added products. We are number one in production and productivity, but there are miles to go in processing, product diversification and exports. CDB is formulating new strategies in the coming plan period to achieve this goal through an aggressive campaign for processing for value addition and collaborative competition among other coconut growing countries. ■

Development efforts in coconut – A journey parallel to the century old research

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Introduction

When we are celebrating 100 years of coconut research in India, a recap on the development agencies and their yeomen service in bringing coconut sector to the prestigious present status would be ideal. When India attained independence in 1947 the research efforts in coconut had surpassed three decades with minimum support for development. The research efforts on coconut made its beginning in 1916 in four research institutes established under Madras Presidency at Pilicode, Nileswaram (two stations) and Kasaragod. There was no specific agency for coconut development at that time. These stations were shouldered with the mandate of research of various coconut growing soil types in northern Kerala and were under the administrative control of Deputy Director of Agriculture, Thalasseri. In 1931 Dr. J.S. Patel, the renowned oil palm scientist took over the administrative control of these research stations. The first attempt in exploiting the hybrid vigour in coconut was started by Dr. Patel during this period. The first TxD hybrid using Tall palm as female parent and Dwarf as male parent evolved which became a revolutionary breakthrough in crop improvement studies in coconut. Organized development efforts in coconut had its beginning just before India became independent. Now that the crop has emerged as the most beneficial crop to the humanity, having global acceptance, the development agencies instrumental behind the process and their efforts and impacts are briefly discussed in the article.


THE
COCONUT PALM
A MONOGRAPH

INDIAN CENTRAL COCONUT COMMITTEE

Indian Central Coconut Committee (ICCC)

The year 1945 marked another significant milestone in coconut sector. The India Central Coconut Committee (ICCC) came into existence with its headquarters at Ernakulam in Kerala state. ICCC was vested with statutory powers for undertaking systematic development and research in coconut. The main functions of the Committee were to undertake, assist and encourage agricultural, industrial, technological and economic research on coconut; to supply technical advice to growers and to persons engaged in coconut industry; to encourage the adoption of improved methods in coconut cultivation; to improve marketing of coconuts and coconut products in India and abroad and suggest

suitable measures to prevent unfair competitions; to promote and encourage cooperative efforts among the coconut growers and the coconut industries; to fix grade standards of copra and its products; and to collect statistics from growers, dealers, millers and other sources on all relevant matters of coconut industry. It was during the Committee's period the extension activities in coconut were given more thrust. The Committee started 'Coconut Bulletin' in 1947 which later on renamed as Indian Coconut Journal and Indian Nalikera Journal, the first ever monthly publication dedicated to coconut in the country. In 1953 its Kannada version also was commenced. The book, 'The Coconut Palm - A Monograph' by Dr. K.P.V. Menon and Dr. K.M. Pandalai still enjoys the status of the best publication ever made on coconut crop.

The Committee implemented several research and development programmes in different coconut growing States. The Committee set up two central coconut research stations one at Kasaragod in the Cannanore District in 1947 to tackle the problems of fundamental research and the other at Kayamkulam in Quilon District in 1948 to investigate the problems connected with pests and diseases. Besides, regional coconut research stations were set up at Kumarakom and Balaramapuram in Kerala, Arsikere in Karnataka; Ambajipet in Andhra Pradesh; Ratnagiri in Maharashtra; Sakhigopal in Orissa and Kahikuchi in Assam with the support of the state governments. At the coconut research station, Kasaragod research on agronomy, botany, cytogenetics and analytical chemistry was intensified by commencing separate divisions for each discipline. The state research laboratory, which was functioning at Quilon, Kerala and Research Station at Kayamkulam, where work on coconut root wilt disease was in progress were also transferred to the Committee. It was during the Committee's period that the germplasm exchange programme was intensified and the collection of indigenous germplasm initiated. Along with adaptive research, technological research on coconut too received attention for the first time during the Committees' period. The Committee designed and popularized improved copra kilns for producing quality copra and promoted studies on processing through CFTRI, Mysore.

The performance of the Committee had reflected in the production front of the period as well. National production which remained at 3332 million in 1950-51 was increased to 5546 million in 1968-69.

Regional Office for Coconut Development

Consequent to the abolition of the Indian Central Coconut Committee, a Regional Office for Coconut Development was formed by the Government of India at the Committee headquarters itself as an interim arrangement to carry out the development activities which were in operation in different parts of the country. The Regional Office functioned only for one year and the same was abolished in 1967 when the Directorate of Coconut Development came into existence.

Directorate of Coconut Development (DCCD)

The Directorate of Coconut Development came into being under the Ministry of Agriculture, Govt. of India in 1967 with the functional responsibilities of planning and co-ordination of central and state sector programmes on coconut development in the country. For assisting in the planning process, an advisory body viz. Indian Coconut Development Council was also constituted giving representation to varied interests in coconut industry. DCCD monitored many Centrally Sponsored programmes viz., production and distribution of quality seedlings, laying out demonstration plots, adoption of plant protection measures, improvement of marketing facilities including establishment of regulated markets, fixation of grade specifications for coconut oil etc. The programmes implemented by the Directorate during different spells are discussed separately. The research activities kept under the ambit of these organizations till then were shifted to the Indian Council of Agricultural Research (ICAR) through the Central Plantation Crops Research Institute (CPCRI) and the Directorate of Coconut Development (DCCD) was solely vested with the development functions of the crop. The Directorate functioned till the formation of the Coconut Development Board in 1981.

Coconut Development Board

The Board was constituted as a statutory body by an act of Parliament viz. Coconut Development Board Act (1979) for the integrated development of coconut industry. The major functions of the Board inter alia include adopting measures for the development of coconut industry, recommending measures for improving marketing of coconut and coconut products, regulating import and export of coconut and its products, adopting measures for assisting coconut growers to get incentive prices for coconut and its products, providing financial and other assistance for cultivation, processing and marketing aspects of coconut, fixing of grade specification and standard of coconut and its products etc.

The headquarters of the Board is located on the land measuring 75 cents, acquired by the erstwhile Indian Central Coconut Committee. The Board commenced implementing development programmes from 1982-83 which was the third year of the Sixth Five Year Plan Period. The development programmes on coconut implemented hitherto by the Directorate of Coconut Development were given new direction by the Board by identifying key areas where efforts were to be concentrated. Location specific programmes were formulated with the objective

of creating permanent production potential, stepping up productivity, developing appropriate technologies for product diversification and improved marketing of the crop. Expansion of area under coconut, production and distribution of quality planting material, technology development, surveys, extension and publicity activities etc. were the major programmes implemented during the period. The Board started three Regional Offices at Bangalore, Patna and Chennai in different periods in order to co-ordinate and monitor the development programmes implemented in various states. Six state centres were also started in Andhra Pradesh, Orissa, West Bengal, Assam, Tripura and Andaman &Nicobar Islands. In the course of time Regional office Patna was wound up giving the unit, the status of state centre and State centre Guwahati was elevated to the status of Regional Office. Recently State centre Patna has reinstated as Regional office. Demonstration cum Seed Production Farms for coconuts with the objective of production of hybrid seedlings as well as to demonstrate the scientific cultivation technologies were started in ten states comprised of traditional and non-traditional areas in an area of 340 ha.

The Board had made a beginning on the technology development of coconut by starting a Technology Development Centre for coconut, attached to the headquarters of the Board which was later on shifted to Vazhakulam in Ernakulam district in a leased land of one acre. At present in addition to the above field network, the Board has got one field unit at Trivandrum and a Market Development cum-Information Centre at New Delhi. The programmes implemented by different development agencies in different Plan periods and their impact are discussed at length under Five Year Plan programmes.

Development efforts during various Five Year Plan Periods

Coconut crop was not brought within the purview of the first Five Year Plan which started in 1951-52 and hence there was no separate allotment of funds for coconut development. However, the Indian Central Coconut Committee which came into existence in 1945 was carrying out its normal development functions. Some of the notable achievements during this plan period were the establishment of large number of coconut nurseries in different coconut growing states and establishment of biological control laboratory units for the multiplication of parasites against coconut pests. The publicity and extension activities were also given priority for popularizing the scientific coconut cultivation by introducing plant protection through several publications and other media. The activities during the First Five Year Plan Period could help in increasing the production level from 3282 million nuts (1950-51) to 4224 million nuts (1955-56) and area from 0.63 million hectares to 0.65 million hectares.

Coconut research and development was brought within the purview of the Second Plan which commenced from 1956-57. Major thrusts were given on the production and distribution of quality seedlings, laying out demonstration plots, adoption of plant protection measures, improvement of marketing facilities including establishment of regulated markets, fixation of grade specifications for coconut oil, etc during this period. The Committee did meritorious service in the field of Agricultural Extension including publicity through its regular and adhoc publications. Sample surveys for the correct estimation of area and yield of coconut and cost of cultivation were taken up in Assam, Kerala, Madras, Mysore, Maharashtra, Andhra Pradesh and in Orissa. Parasite breeding stations for biological control of nephantis were first started during the second plan period. The Committee set up special sub-committee for organizing technological research through the existing technological institutes in the country. Schemes for the solvent extraction of oil from coconut oil cake and preparation of charcoal from coconut shell were sanctioned to be taken up at the Regional Research Laboratory at Hyderabad while preparation of vinegar from coconut neera and processing of de-oiled coconut cake so as to render it suitable for human consumption were sanctioned to be taken up at the Central Food Technological Research Institute, Mysore. The development activities undertaken during the period could bring about beneficial impact on coconut production, which reached the level of 4639 million nuts in 1960-61. The development activities undertaken during the period could bring about beneficial impact on coconut production, which reached the level of 4639 million nuts in 1960-61.

During the Third Plan period commenced in 1961-62, more emphasis was given to production oriented programmes in traditional coconut growing belts. The developmental activities of the second five year plan period were expanded and continued during the Third Plan. In addition, short-term production and productivity improvement measures like application of fertilizers and manures and adoption of irrigation facilities were also

introduced. A steady increase in coconut production was observed during this plan period. By the end of the Plan period the production was reached to 5035 million nuts which was 396 million nuts more than the production level recorded in 1960-61. During the mid Plan Period a study on coconut in India was undertaken under the aegis of the Committee on Natural Resources under the Chairmanship of Dr. M.S.Randhawa, Adviser (Resources) Planning Commission. The objective of the study was to analyse development measures taken till the period in the production of coconut, how far they could succeed and how far they had failed to achieve the set objectives. The outcome of the study posed potential for further expansion of coconut cultivation in Madras, Orissa, Gujarat and the Islands of Andaman, Nicobar, Laccadive and Minicoy. The scope for coconut cultivation along the banks of canals, bunds as well as in saline waste lands in the coastal belts as well as the potential for expanding the nursery programme was indicated in the study. The study also indicated an immediate need for survey of potential areas for coconut cultivation. Other observations which had a bearing on the coconut development in future were, package programme, compulsory grading of coconut oil for edible purpose, study on the demand and supply for the next 20 years and also to exploring the possibility of cultivation of African Oil Palm in suitable areas in the context that palm oil is a good substitute for coconut oil in soap making. Palm oil, however, made deep rooting as a strong substitute of other edible oils at later stage.

The third plan period was followed by plan break for three consecutive financial years ie. 1966-67, 1967-68 and 1968-69. During these years the programmes implemented previously were continued. New schemes viz. TxD seedlings production programme, establishment of Elite Seed Farm in Karnataka and subsidized supply of quality coconut seedlings in Gujarat were additionally sanctioned as Centrally Sponsored Schemes. During this period the production level reached 5546 million nuts and the area 0.99 million hectares.

A large number of short term and long term production programmes were taken up during the fourth Plan Period which began in 1969-70. The objective was to achieve an additional production of 1000 million nuts over a base level production of 5546 million nuts. However, some of the important short-term programmes like Package Scheme could not be taken up from the beginning. Nevertheless, it was in the Fourth Plan that some of the strategic long term production programmes kicked off. Production and distribution of hybrid planting material in the state of Kerala, Karnataka, Tamil Nadu and Andhra Pradesh, establishment of elite seed farm for TxT progenies in Karnataka and subsidized supply of quality planting material in Gujarat were implemented as Centrally Sponsored Schemes. In the state sector, expansions of area under coconut and nursery programmes were taken up as long term measures. By the end of the fourth plan period the area under coconut increased to 1.102 million ha and production to 5851 million nuts.

During the Fifth Plan Period besides continuing the long term programmes initiated during the Fourth Plan, short-term productivity oriented programmes namely package scheme, laying out demonstration plots, production and distribution of TxD and DxT hybrid combinations, maintenance of elite farms, etc. were continued. In addition, surveys on cost of cultivation, coconut production and processing aspects also were undertaken during this plan period. Plant protection measures were given adequate thrust by adopting comprehensive spraying programmes, multiplication of parasites etc. A rejuvenation programme in the coconut root wilt disease affected plantations in Kerala was also introduced for the first time during the plan period. The production level touched 5662 million nuts

During the Sixth Plan Period which commenced in 1980-81, the development strategy took a new dimension with the formation of Coconut Development Board(CDB) on 12th January, 1981 as per Coconut Development Board Act 1979. Directorate of Coconut Development ceased it's functioning with the establishment of the Board which monitored the implementation of the programmes implemented by the state governments till the formation of the Coconut Development Board in 1981. The Directorate of Coconut Development (DCD) ceased to exist with the formation of Coconut Development Board. But the Centrally Sponsored programmes monitored by the Directorate like package scheme, production and distribution of TxD seedlings, laying out demonstration plots, maintenance of elite farms etc. were continued.

The Board was mandated with the responsibility of formulating location specific programmes for the integrated development of coconut cultivation and industry in India. Board commenced implementing development programmes from 1982-83 which was the third year of the Sixth Five Year Plan Period. Coconut development activities were given new dimension with the objective of creating permanent production potential, stepping up productivity, developing appropriate technologies for product diversification and improved marketing of the crop. Expansion of area under coconut, production and distribution of quality planting material, technology development, surveys, extension and publicity activities etc. were the major programmes implemented during the period. The Board started one Regional Office at Bangalore during this period to co-ordinate and monitor the development programmes in Karnataka, Goa and Maharashtra. A Demonstration Cum

Seed Production Farm for coconut was also established at Mandya, Karnataka during this period. A comprehensive survey to assess the intensity of root wilt disease was carried out jointly by CPCRI, Department of Agriculture and Coconut Development Board in 1984 which brought out a production loss of 968 million nuts annually due to root wilt disease.

By the end of the Sixth Plan Period the area under coconut reached at 1.183 million ha and the production 6913 million nuts

The development programmes of the Board received further impetus during 1985-86 with the onset of Seventh Five Year Plan. The technology development which made a beginning in the Sixth Plan Period got widened during the seventh plan period by starting a technology development centre for coconut, attached to the headquarters of the Board which subsequently shifted to Vazhakulam, Ernakulam district in a leased land of one acre. Studies on product diversification giving emphasis on developing new products like coconut cream, bottling of coconut water, coir pith briquetting, timber utilisation, etc. were initiated under sponsored research programmes through the reputed research organisations like RRL, CFTRI, DFRL and MERADO. Since the importance of scientific management practices in coconut was felt essential, establishment of demonstration cum seed production (DSP) farms in different locations both traditional as well as non - traditional belts was taken up as a major activity. DSP farms were initiated during this plan period in Madhya Pradesh, Assam, Tripura and Bihar with the objective of demonstrating scientific coconut cultivation in these non-traditional belts and developing reliable sources of different cultivars and hybrids besides being a source of income to the Coconut Development Board.

Coconut cultivation in Kerala was under the grip of devastating root wilt disease. Cutting and removal of disease affected palms by giving compensation to the farmers along with introduction of improved management practices was a priority area during the Plan period with the objective to improve the productivity of coconut. This was in tune with the research recommendation that eradication of root(wilt) disease advanced palms and replanting with quality seedlings coupled with proper management would improve productivity of coconut.

It was during this period the Board could expand its field network. Second regional office of the Board was established in Patna, Bihar during 1985 to coordinate and monitor the development activities in the north and north eastern regions like Madhya Pradesh, Bihar, Tripura, Assam, Orissa, Manipur, West Bengal and U.T. of Andaman and Nicobar Islands. For close liaison with the state Agri/Hort. Department and direct implementation of some of the developmental activities, State Centres

were also established in the States under the jurisdiction of the Regional Office, Patna. Concerted efforts of these State Centres and Regional Offices could bring about notable improvement in the overall area, production and productivity level in the country and could boost the image of the Coconut Development Board at the national level especially in the north and north eastern states. In 1986 Government of India commenced the fixing of support price to copra, an initiative which is continued even now as a support measure to protect coconut farmers. The area under coconut reached the level of 1.47 million ha and production 9359 million nuts by the end of VII Plan Period.

With the initiation of a computerized coconut information centre at the headquarters, the Information network of Coconut Development Board was expanded with the objective of exchanging up-to-date information on all aspects of coconut industry among the major coconut growing countries in the world under the Integrated Coconut Information Service Programme (ICISP) initiated by the Asian Pacific Coconut Community (APCC).

Another milestone during this period was that an apex body in co-operative sector was registered in 1987 viz. KERAFED. The primary objective of KERAFED was to organize coconut growers by bringing them under the co-operative umbrella and to provide them with supplies and services to augment their income base by increased productivity and value additions. This was proposed to be achieved through an integrated system of production, procurement, storage, processing, product diversification and marketing of coconut and coconut products at prices remunerative to producers and acceptable to consumers on a sustained basis. For taking up these activities about 900 Primary Agricultural Credit Societies (PACS) were brought under the purview

of Kerafed. A full-fledged copra processing plant was established by the Kerafed at Karunagapally in Kollam District with the annual processing capacity of 60,000 MT. Coconut oil marketed by Kerafed in consumer pack with the brand name 'Kera" was well accepted by the consumers and could generate considerable domestic and international demand for coconut oil.

The seventh plan period was followed by two plan holidays in 1990-91 and 1991-92. During these periods, programmes implemented during the Plan period were continued. A major policy decision was taken in 1990 declaring coconut as an 'oilseed crop of tree origin' by Govt. of India for giving more thrust for coconut development. But it was a fact that preference received by seasonal oilseeds was not made available to coconut. One State Centre Office of the Board was started in Andhra Pradesh during 1990-91 to implement and monitor developmental activities in close liaison with the State Horticulture Department.

The developmental programmes on coconut received further boost in 1992-93 with the approval of Eight Plan programmes. An enhanced budget outlay from 10 crores allotted in previous Plan to 79.29 crores helped to formulate more viable schemes. Major thrusts was given on the production and distribution of planting material, expansion of area under coconut and technology development as well as productivity improvement programmes like integrated farming in coconut holdings, integrated control of major pests and diseases, etc. Extension and publicity activities were also strengthened during the period. The activities of the DSP Farm Belbari, Tripura was disrupted during the period due to terrorist activity. Two more farms of 20 ha each were started in Kerala during the Plan Period in Ernakulam and Thrissur districts. Another 40 ha was alienated to Coconut Development Board by the Govt. of Andhra Pradesh for starting a farm at Vegiwada.

This period was witnessing serious allegation against coconut oil consumption in the pretext that it causes coronary artery disease (CAD). A study was entrusted to Biochemistry department of Kerala University under the guidance of Dr. T. Rajamohan on 'Effect of consumption of coconut kernel and coconut oil on the serum lipid profile' was concluded in 1995 which brought out positive results in favour of coconut oil. The Board hosted one of the international events of APCC in Kochi in 1995. In 1996 the HQs of Coconut Development Board started functioning in the 10 storied building constructed in its own land measuring 75 cents at the heart of the Cochin city. A second survey on root wilt disease was sponsored by Board through CPCRI and Department of Agriculture in 1996 which revealed reduction in intensity of root wilt disease to 24.05 %.

The Ninth Plan programmes of Board got clearance in 2001-02, though the first year of the Plan was 1997-98. During the first three years the development programmes implemented during the Eighth Plan were continued. Establishment of two more farms was initiated during this period, one each at Vegivada (Andhra Pradesh), which alienated in previous plan end and Pitapilly (Orissa). The launching of a Technology Mission on Coconut for bridging the gap in the then existed measures, hosting of 37th Cocotech of APCC, rendering financial assistance of Rs.12.225 crores to the Government of Andhra Pradesh for rehabilitation of cyclone affected coconut gardens etc., were milestones. The national production level touched 12252 million nuts by 1999-2000. A study to find out the impact of consumption of coconut oil on Coronary Artery Disease was entrusted to Sree Chitra Tirunal Institute of Medical Sciences and Technology and the study results revealed negative correlation. The achievements of the Coconut Development Board were duly acknowledged by Asian and Pacific Coconut Community by honoring it with 'Tree of life" award.

The coconut plantations in the country confronted a severe setback in 1998. A dreaded pest, coconut mite, eriophyes guerrironis made a rampant spread in the plantations in the country which hit the production front and seriously affected the coir sector. Intervention of research and development agencies in controlling the menace worked out well, despite its prevalence in moderate level in many parts.

The Tenth Plan was initiated in 2002-03. The appointment of Smt. Minnie Mathew, as the first IAS Chairman of the Board gave new impetus to the vision and mission of Board. The programmes of the Board were dovetailed in such a way that coconut farmers also become part and parcel of implementation of Government schemes. The scattered nature of small and marginal farmers was a hindrance in production, processing and marketing front. Farmer participatory coconut clusters were formed and they became the conduits in implementing productivity improvement programmes. This had created overwhelming enthusiasm among the farming community. Technology Mission on coconut made strong footing and several coconut based industries started in various parts of the country by availing back ended credit capital subsidy from the Board. Product development gained momentum and many value added products were added to the series. A well planned multi media campaign highlighting the health benefits of coconut products was carried out in the length and breadth of the country which culminated in boosting the demand for coconut products especially coconut oil and tender coconut water even in non - producing areas.

The coconut festivals in 2005 and 2007 in Kochi

No. 4-73/2006-Hort.II
Government of India
Ministry of Agriculture
Department of Agriculture & Cooperation

Krishi Bhavan, New Delhi
Dated the 1st May, 2009

To

The Chairperson,
Coconut Development Board,
Kera Bhavan, SRVHS Road,
Kochi – 682011

Subject: Implementation of the Project "Replanting and Rejuvenation of Coconut Gardens in Districts of Thiruvananthapuram, Kollam and Thrissur in Kerala and Union Territory of Andaman and Nicobar Islands" – Issue of NOC – Applicability of Model Code of Conduct - regarding.

Madam,

I am directed to say that the Cabinet Committee on Economic Affairs (CCEA) has approved the implementation of the Project mentioned above at a project cost of Rs. 2275.643 crores, with a Central subsidy of Rs. 478.304 crores over a period of 5 years from 2009-10 to 2013-12. Administrative Approval for the current year will be issued in due course.

2. This is for your information and further suitable action in the matter.

Yours faithfully,

(S. Jeyakrishnan)
Under Secretary to the Government of India

GOVERNMENT OF INDIA
MINISTRY OF COMMERCE AND INDUSTRY
DEPARTMENT OF COMMERCE

PUBLIC NOTICE NO. 169 (RE-2008) /2004-2009
NEW DELHI DATED THE 1st April, 2009

In exercise of powers conferred under Paragraph 2.4 of the Foreign Trade Policy 2004-2009, the Director General of Foreign Trade hereby makes the following amendments in Appendix 2 (List of Export Promotion Councils/ Commodity Boards) of the Handbook of Procedures (Vol.1):

Coconut Development Board has been added in Appendix 2 at S. No. 36:

S. No.	Name of Export Promotion Councils/ Commodity Boards	Registered Office/ Head Office	Regional Office	Details of products falling within their jurisdiction
36.	Coconut Development Board	Coconut Development Board, Kera Bhavan, SRVHS Road, Kochi - 682011 Tel : 0484-2375216 Fax : 0484-2375216		All coconut products other than those made from coconut husk is fiber

This issues in Public Interest.

Sd/-
(R.S. Gujral)
Director General of Foreign Trade
And Ex-Officio Additional Secretary to the Govt. of India
(Issued from File No. 01/93/180/58/AM09/ PC-II(E)

and Trivandrum and the international seminar in Goa were memorable events. Coconut farmers, exporters, manufacturers, industrialists etc who have excelled in respective field were honored by giving national awards for the first time in 2006 which is still continuing.

2007-08 marked the first year of the Eleventh Five Year Plan period. A massive programme for replanting and rejuvenation of coconut gardens in Kerala and Andaman & Nicobar Islands was cleared by Government of India in May, 2009 as a Central Sector scheme. The total cost of the project was Rs. 2275 crores with a subsidy component of Rs.478.50 crores. It remains as the highest allocation a single crop ever received. Another milestone in this period was notification of Coconut Development Board as Export Promotion Council (EPC) for all coconut products other than coir and coir based products. This positioning helps the Board to monitor the export movement of all products meticulously. Board issues mandatory Registration cum Membership Certificate (RCMC) to exporters, enabling the export procedure.

By the end of the eleventh plan Shri. T.K. Jose, another IAS officer took over charge of Chairman, which gave lot of encouragement to the farming community. The new initiatives visualized and put in operation by Shri. T.K. Jose helped to mark an unprecedented image boost to the Board at national and international level. The activities like 'Friends of coconut' with the intention to create sufficient manpower in palm climbing and plant protection, aggregation of farmers into three tier system of Coconut Producers Societies(CPS), the basic tier, Coconut Producers Federation(CPF), the middle tier and the apex structure of Coconut Producer Company(CPC) with the objective of empowering the small and marginal famers, intensification of crop insurance in coconut, kera suraksha for coconut climbers, popularizing neera production and its wide usage as a health drink, skill development in neera extraction and production of downstream products from neera received accolades and international recognition. Many countries expressed interest to emulate the efforts. India got the opportunity to host the 51st Session of APCC which could showcase India's strength before other countries.

We are now in the close of the twelveth Plan period. It is a moment to feel proud in the proper positioning of Indian coconut sector at the global arena and in the India's premier status in production and productivity. The country is marching towards a prominent position in export sector too. The country has recorded perceptible growth in export of products like coconut oil and activated carbon. We are number one in the export of activated carbon. Export value from coconut products has surpassed that from coir and coir products. Indian products are moving to different destinations viz., US, France, Japan, Germany, UAE, Africa, Pacific Islands and so on. The wide gap prevailed in domestic and international price for coconut products narrowed down and recently moving in reverse trend which opened up new vistas for India in export promotion.

What next?

Achievements recorded in research front by CPCRI in crop improvement, crop management, crop protection and technology development are praiseworthy. State Agricultural Universities and a few private organizations are carrying out research in certain discipline. State Agri/Horti departments support development activities of coconut. Amidst these prestigious achievements, challenges and issues are many in coconut sector. Pests and diseases, natural calamities, impact of climate change, low productivity etc., often hinder the linear growth. At the same time relevance of coconut as a food crop with many nutritional and medicinal properties enhances its importance and acceptance world over. This state of affair warrants more focused R&D efforts in coconut and reinforces the need for concerted collaborative efforts by organizations and agencies at national and international level. ■

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Effect of Photo periodicity and Carbon dioxide assimilation on growth of coconut seedlings

Jyothi V Hosamath, Technical Officer **and Sasikumar C** Farm Manager i/c
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Introduction

Plant experiences a number of developmental phases during its life cycle. The transition starts from germination to juvenile vegetative phase and then to reproductive stage. The growth and development of the plant is affected by many factors such as genotype, soil moisture, temperature, relative humidity, photo periodicity, carbon dioxide assimilation etc. Therefore, this present investigation was undertaken to study the impact of growth of coconut seedlings on extended photoperiodism and carbon dioxide assimilation.

Materials and Methods

The experiment was started during August 2015 at the D. S. P. Farm, Mandya. The nuts of different genotypes such as WCT, COD, MYD and CDG X TT were sown in polybags. The extended photoperiodicity is given by electric light at night and carbon dioxide assimilation is given externally. The observations were recorded for plant height (cm), collar girth (cm), number of leaves and leaf width (cm).

Results and Discussion

The data pertaining to plant height, collar girth, number of leaves, leaf width were collected at 180 DAS, 210 DAS, 240 DAS, 270 DAS and 300 DAS and are presented in Table 1, 2, 3 and 4 respectively.

The growth characters of coconut seedlings such as plant height, collar girth, number of leaves and leaf width have shown better growth under the treatment

Table 1: Extended photoperiodicity and carbon dioxide assimilation on plant height of coconut seedlings at 180, 210,240, 270 and 300 DAS

S.No.	Genotypes	Under Treatment					Under Control				
		Plant height (cm)									
		180 DAS	210 DAS	240 DAS	270 DAS	300 DAS	180 DAS	210 DAS	240 DAS	270 DAS	300 DAS
1	WCT	84.40	97.50	112.50	121.75	130.00	61.25	78.00	98.25	106.00	115.25
2	COD	67.75	80.00	90.00	93.75	98.25	61.50	70.00	87.00	89.50	92.50
3	MYD	58.50	76.25	86.25	92.00	99.50	43.75	44.00	55.50	66.50	82.25
4	CDG x TT	75.50	79.25	80.25	86.75	94.00	68.75	73.75	77.50	85.75	97.75

Table 2: Extended photoperiodicity and carbon dioxide assimilation on collar girth of coconut seedlings at 180, 210,240, 270 and 300 DAS

S.No.	Genotypes	Under Treatment					Under Control				
		Collar Girth (cm)									
		180 DAS	210 DAS	240 DAS	270 DAS	300 DAS	180 DAS	210 DAS	240 DAS	270 DAS	300 DAS
1	WCT	10.75	12.75	13.50	13.75	14.25	9.00	11.50	12.25	13.00	13.50
2	COD	9.75	11.25	11.50	11.75	13.25	9.50	9.75	10.50	11.00	11.75
3	MYD	9.00	10.75	10.75	11.50	12.00	9.00	9.25	10.00	10.75	10.75
4	CDG x TT	9.75	10.75	11.00	12.00	13.50	9.75	10.25	11.50	12.00	12.50

of extended photoperiodicity and carbon dioxide assimilation treatment compared to normal condition.

Under the treatment of extended photoperiodicity and carbon dioxide assimilation WCT shows taller plant height at 180 DAS, 210 DAS, 240 DAS, 270 DAS and 300 DAS, whereas MYD shows shorter plant height at 180 DAS and 210 DAS. In case of CGD X TT the plant shows shorter plant height at 240, 270 and 300 DAS. The thickest collar girth was observed in WCT and thinner collar girth found in MYD at 180 DAS, 210 DAS, 240 DAS, 270 DAS and 300 DAS. CGD X TT recorded maximum number of leaves whereas WCT recorded minimum number of leaves at 180 DAS, 210 DAS, 240 DAS, 270 DAS and 300 DAS. The broadest leaf width was noticed in COD, CGD X TT shows narrow leaf width at 180 DAS, 210 DAS, 240 DAS, 270 DAS and 300 DAS.

Conclusion

From the study it was found that the coconut seedlings shows better growth under the treatment of extended photoperiodicity and carbon dioxide assimilation compared to normal condition. Among the four varieties WCT shows better growth compared to other varieties. ■

Table 3: Extended photoperiodicity and carbon dioxide assimilation on number of leaves of coconut seedlings at 180, 210,240, 270 and 300 DAS

S.No.	Geno-types	Under Treatment					Under Control				
		Number of leaves									
		180 DAS	210 DAS	240 DAS	270 DAS	300 DAS	180 DAS	210 DAS	240 DAS	270 DAS	300 DAS
1	WCT	4.25	5.00	5.75	6.25	6.75	3.75	5.00	5.75	5.75	6.25
2	COD	4.25	5.50	6.00	6.00	6.25	4.00	5.25	6.00	6.25	6.75
3	MYD	4.25	5.50	6.25	6.50	6.75	4.00	4.50	5.25	5.50	5.25
4	CDG x TT	4.50	5.50	6.25	6.50	7.25	4.50	4.50	5.00	6.00	6.00

Table 4: Extended photoperiodicity and carbon dioxide assimilation on leaf width of coconut seedlings at 180, 210,240, 270 and 300 DAS

S.No.	Geno-types	Under Treatment					Under Control				
		Leaf width (cm)									
		180 DAS	210 DAS	240 DAS	270 DAS	300 DAS	180 DAS	210 DAS	240 DAS	270 DAS	300 DAS
1	WCT	17.00	15.50	17.75	19.50	21.25	12.50	13.25	17.50	19.75	21.25
2	COD	12.25	17.25	19.00	20.50	22.50	10.50	11.75	13.50	14.75	15.00
3	MYD	13.00	14.75	15.25	17.00	16.25	9.50	9.50	9.75	10.00	12.00
4	CDG x TT	11.75	12.50	12.75	14.25	14.25	10.75	10.75	12.00	14.75	17.00

Research into use –

The context of coconut technologies

● **Thamban, C. and Jayasekhar, S.**
ICAR-Central Plantation Crops Research Institute, Kasaragod

Introduction

In India, coconut farming is inseparably embedded in the socio-economic and cultural fabric and also represents the ethnic identity. Therefore it is not always possible to view the commercial aspects of coconut farming in isolation. This is exactly the reason for, why the coconut cultivation in the country still sustains overcoming all the topsy-turvy terrains in the past. It is unique that the coconut sector has been evolved through imbibing the scientific excellence for the past 100 years. Hundred years of coconut research has yielded substantial number of technologies pertaining to agro-techniques, farming systems, pest and disease management, and value addition for enhancing yield and income from coconut farming. The focused research efforts to improve productivity and overall profitability to the farmers resulted in the development and release of high yielding varieties and hybrids. Eighteen improved high yielding varieties including twelve selections and six hybrids were released from the ICAR-Central Plantation Crops Research Institute (CPCRI) alone. The coconut based cropping system (CBCS), and coconut based mixed farming system (CMFS) models evolved through systematic research categorically proved the advantages of the system approach. However, it is a matter of grave concern that in spite of all the concerted research efforts in the coconut sector for the past 100 years, the level of technology utilisation by coconut growers is not up to the desired level as revealed by many studies. Therefore, it is very pertinent to look into the existing pattern of technology development and extension process in the coconut sector in the country with a view to identify the inherent structural issues and other major constraints that stand as an obstacle in the path of effective translation of the technology to the farmers' fields.

Field level utilisation of technologies in coconut

Various agencies are involved in the efforts for the development/transfer of technology in coconut as part of the broader innovation system. The ICAR-Central Plantation Crops Research Institute (ICAR-CPCRI)

and State Agricultural/Horticultural Universities are the major actors in the generation of coconut technologies. Besides, they also conduct front-line TOT programmes in coconut. State Agri/Horticultural Universities also organise front line extension activities for the promotion of coconut. Krishi Vigyan Kendras (KVKs) implement interventions for technology assessment and front line extension activities related to coconut which is important in the prevailing cropping systems of the respective districts they are located. Mainstream extension system with Ministry of Agriculture at the centre and State Agriculture/Horticulture Departments at state level implement technology transfer and development schemes for the improvement of coconut. Extension programmes relevant to coconut are also implemented through the Agricultural Technology Management Agency (ATMA) initiative supported by Central and State governments. Coconut Development Board under Ministry of Agriculture is also functioning for the development of coconut. Farmer organisations supported by governmental agencies also involve in the implementation of extension and development interventions in coconut sector. For example, the three tier network of Coconut Producer Societies (CPSs), Coconut Producer Federations (CPFs) and Coconut Producer Companies (CPCs) facilitated by CDB are actively involved in organising extension/development activities. Local Self Governments (LSGs) also implement development interventions in coconut through decentralised planning process.

Though a plethora of agencies and initiatives are involved in implementing research/development/ extension interventions to improve the livelihoods of farmers in coconut sector, the extent of field level utilisation of technologies for realising higher productivity and income from coconut farming has been not at a satisfactory level. Studies conducted by ICAR-CPCRI showed that adoption of coconut hybrid varieties, improved irrigation techniques like microirrigation, IPM, IDM and post harvest processing technologies was very low. A comparison between the best managed gardens and national average of productivity of coconut reveal the fact that there still exists a wide gap between the technologies generated and their utilization by the growers, especially in small holdings. The low level of technology utilisation at farmers' fields calls for formulating effective research and extension strategies suitable to the heterogeneous farming situations in coconut sector.

Coconut sector in India faces a number of challenges to attain economic and ecological sustainability. Price crash/price fluctuation in the market is the most important problem experienced by coconut growers. The risk and uncertainty due to price fluctuation faced by farmers is more serious in the present era of trade liberalization unlike in the past when domestic markets were highly protected from outside competition. The scenario has completely changed resulting in greater integration of the domestic market with the world market necessitating pro-farmer government interventions based on farmer friendly policies and programmes.

Strategies for inclusive growth in India can't overlook coconut sector owing to the significant contribution of plantation crops sector towards the livelihood security of millions of small and marginal farmers as well as plantation workers, especially women. Apart from favourable policy environment and pro-farmer interventions, it is also essential that efficiency of farming is enhanced considerably by the effective utilisation of technologies made available for increased productivity and income from coconut. Effective extension strategies are to be formulated and implemented in tune with the socio-economic and bio-physical environment of cultivation of coconut to ensure better technology uptake for higher efficiency in the sector. Strategies suggested to overcome the difficulties due to low price/ price fluctuation in small holders' crops such as coconut include enhancing productivity and reducing cost of cultivation, adoption of cropping/farming system rather than monocropping and value addition through product diversification. However, conventional TOT strategies focusing mainly on increasing production of crops are not adequate to empower small and marginal farmers to take up interventions including production and marketing

of value added products. Hence, appropriate extension approaches to facilitate formation and sustenance of farmer organisations at grass root level becomes highly relevant.

Predominance of small and marginal holdings is a constraint experienced by the coconut sector in achieving efficiency in production. The inherent problems due to fragmented holdings with low resource endowments result in low level of adoption of improved technologies. Hence, it is imperative that group approaches are facilitated among small and marginal growers in coconut sector for effectively implementing extension and development initiatives. Group approaches enable the growers to reduce cost of cultivation and to enhance productivity through better utilisation of technologies. Community approach is highly relevant in implementing technology interventions for pest/disease management and managing value addition enterprises. Women Self Help Groups can be empowered for managing microenterprises on production and marketing of value added products in crops like coconut. A major constraint perceived by farmers in the adoption of high yielding/ hybrid varieties of crop like coconut is lack of availability of quality planting materials. Farmer organisations and women self help groups can be facilitated to manage decentralised community nurseries for production and distribution of quality planting material to benefit the growers.

One of the reasons attributed to the unsatisfactory technology adoption scenario in plantation crops is low awareness/knowledge level of farmers about the improved technologies. Hence, capacity development initiatives to benefit farmers are to be organised to better equip them for higher level of utilisation of technologies. Need based training programmes, demonstration of proven technologies with the active participation of farmers, effective use of other extension methods including group/mass contact methods are necessary to keep the growers updated on the technologies available for enhancing productivity and income from farming. Lack of availability of labour, especially skilled labour, and high wage rate are major problems experienced by growers. Hence, capacity development programmes for knowledge/skill upgradation of labour community, especially skilled labour, is highly significant for enhancing efficiency in plantation sector. Potential of cyber extension methods also needs to be exploited to reach the farming community. Capacity development initiatives are to be conducted for the benefit of extension personnel.

It is generally an accepted fact that the extent of farmers' participation in research and extension is not at a satisfactory level. Active involvement of farmers

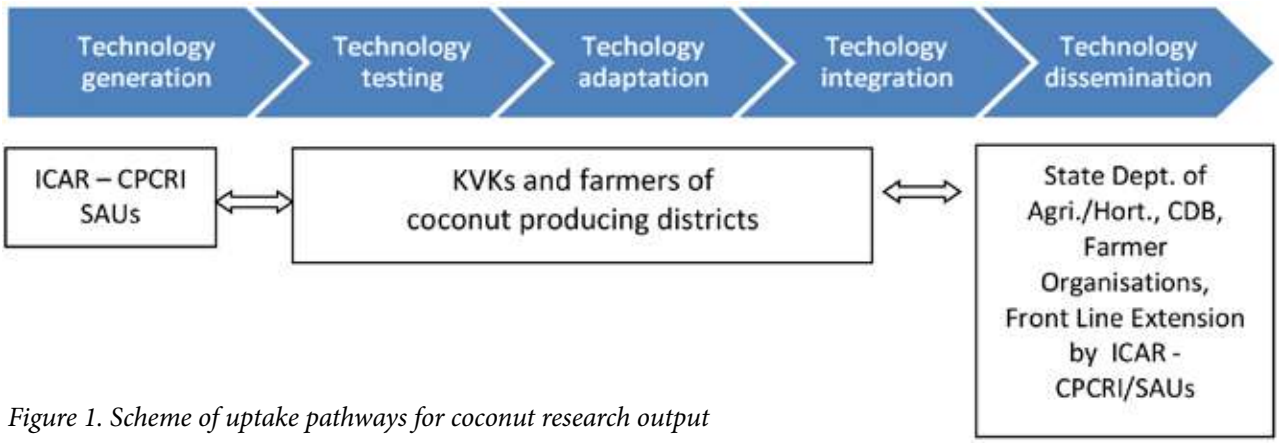

Figure 1. Scheme of uptake pathways for coconut research output

in the process of technology generation, technology assessment and refinement and dissemination of technologies invariably enhances the extent of technology utilisation at farm level. The scope for implementing farmer participatory approaches to enhance effectiveness of research and extension in coconut needs to be fully utilised.

The underpinnings of uptake pathways

The uptake of the research output by the end user/farmer is mainly influenced by the appropriateness of the output/ technology to the farmer. As a matter of fact, the appropriate outputs which are not taken up by farmers are much less common than research projects which produce inappropriate outputs (Garforth, 1998). The instances of inappropriate outputs include technologies that are incompatible with existing production or marketing system, are too expensive, labour intensive, not suitable for resource poor farmer etc. The technology development is a heuristic concept that involves continuous activities, from basic research, technology generation, testing of technology developed, and technology integration into the existing system (Edward and Farrington, 1993; Sen and Garforth, 1996). Even in the case of disseminated technologies, the uptake necessarily requires perfect adaptation to fit production, processing and operating systems. Theoretically, the uptake of research output can be speeded up through revamping the institutional structures ensuring desired participation of end user groups, and also through ensuring the optimal level of involvement of the farmer in the dissemination process.

Figure 1 above depicts the uptake pathway for coconut research output in India. In the technology generation node, Institutions like ICAR-CPCRI, Agricultural universities, and All India Coordinated Research Project (Palms) are the major institutions accountable. It is imperative to analyze, how far the technology generation node has identified the research output according to the felt need and feed back of the end user. Krishi Vigyan Kendra's (KVKs) are the major institutions responsible for technology validation and technology integration. We need to assess the effectiveness of these channels in technology development process, and whether adequate numbers of on farm testing are conducted to convince the merits of the technology to the farmers. The technology dissemination part of the coconut research is carried out mainly through the respective state departments of agriculture. This is the crucial node and the agriculture departments of most of the states are not properly equipped with exclusive tools for technology dissemination in the coconut sector.

Technology generation

As it was already mentioned, ICAR-CPCRI and SAUs are the major institutions functioning in the domain of technology generation. A quick glance at the technology generation streams of these institutions highlights that the research methodologies are skewed and confined mainly to the on-station/experimental conditions. Though the technologies developed are robust with respect to the scientific evaluation criteria, the practicability of the same in the field level scenario is a matter to contemplate. The appropriateness of technologies to socio-economic resource levels, agro-ecological situations, input use level, low price of coconut, fragmented holdings and changing agrarian relations have become highly debatable.

Research related to coconut breeding has been mainly focussed on strengthening genetic resources and utilisation of these resources to develop high yielding varieties. Evaluation of promising lines in multi locational trials was possible with limited number mother palms and parents of hybrids only due to constraints in land availability. A paradigm shift in breeding strategies is needed to overcome these limitations. In-situ germplasm evaluation and farmer participatory approach in coconut breeding will provide opportunities to take into account the preferences of coconut growers and suitability of the varieties for different agro-ecological situations and resource characteristics of farmers while evolving improved varieties. It will also improve the availability of mother palms and make it possible to produce planting

material in required quantity for faster spread of new varieties to enhance productivity of coconut.

Developing different models of coconut based cropping/farming systems for higher productivity and income from unit land area has been a major contribution of coconut research which is highly relevant in the present day context of price crash of coconut and also in the coconut farming scenario dominated by small and marginal holdings. The agronomic feasibility and economic viability of adoption of coconut based farming systems have been amply demonstrated in research stations. In spite of the obvious benefits of coconut based farming system over the traditional monoculture, the extent of adoption of the recommended farming system models is not at a satisfactory level. Hence, it is necessary to reorient farming system research in coconut with emphasis on characterisation and assessment of coconut based cropping/farming system adopted by farmers in major coconut growing tracts in the country. This would generate data on various techno-socio-economic aspects of land use pattern and management trends in the coconut gardens in farmers' fields so as to facilitate further research initiatives for enhancing the efficiency of coconut based cropping/farming systems adopted by farmers.

Ensuring farmer participation in research and extension invariably enhances the extent of technology utilisation at farm level. There is scope for participatory technology assessment and refinement in coconut for achieving higher productivity. CPCRI was one of the selected centres to implement the Indian Council of Agricultural Research (ICAR) project for Technology Assessment and Refinement through Institution-Village Linkage Programme (TAR-IVLP) under National Agricultural Technology Project (NATP). Implementation of the project revealed the effectiveness of participatory approach in the performance assessment of various technologies related to intercropping, nutrient management, crop protection and value addition in coconut. However, the participatory approach for technology assessment and refinement was not sustained/ institutionalised subsequently.

Technology testing, adaptation and integration through KVK system

The study conducted among 20 KVKs in south India which are functioning in the major coconut producing districts revealed that many of the KVKs have not taken up on farm testing or front line demonstration of technologies evolved at either ICAR-CPCRI or SAUs/ AICRPs which are the major technology generating centres for coconut. Only five per cent of KVKs have conducted OFT/FLDs on technologies related to improved varieties and product diversification. The vital role of KVK system as an intermediary agency between research and extension systems in the agricultural technology development process has been well recognised (Sajeev and Venkatasubramanian, 2010). The inadequate efforts for testing, adaptation and integration of coconut technologies through KVK system adversely affects the process of technology assessment and refinement essential for better technology uptake in farmers' field.

Table 1. On Farm Testing /Front Line Demonstrations of coconut technologies conducted through KVKs

Technology	No of KVKs conducting OFTs/FLDs on coconut technologies	Percentage of KVKs
Improved varieties, hybrids etc	1	5
Agrotechniques like INM, irrigation and water management etc	5	25
Cropping/farming system	4	20
IPM/IDM	6	30
Value addition through product diversification	1	5

It is necessary to facilitate the KVKs in the major coconut producing districts in the country for including relevant interventions for on farm testing and frontline demonstrations of coconut technologies so that upscaling of technologies can be ensured through appropriate technology dissemination initiatives by the coconut extension system represented mainly by the state department of agriculture/horticulture and other agencies. Due to the perennial nature of coconut, there

are many constraints/limitations for formulating and implementing interventions for on farm testing and front line demonstrations of technologies pertaining to coconut compared to technologies in field crops/short duration crops. Specific methodologies/protocol for conducting OFTs and /FLDs are to be evolved and KVK personnel are to be trained on the same to ensure testing, adaptation and integration of coconut technologies through KVK system to facilitate better technology uptake at farm level.

Technology dissemination

Technology dissemination system in coconut in India is mainly represented by State Department of Agriculture/Horticulture and Coconut Development Board (CDB). A large number of development/extension programmes are implemented by CDB for promotion of coconut farming in the country. These programmes are implemented in collaboration with state government agencies, farmer co-operatives and farmer producer organisations. The fact that CDB does not have network of field staff/extension personnel reduces the quality of implementation of the extension programmes to promote field level utilisation of coconut technologies. Though farmer participatory technology transfer approaches have been evolved and validated in coconut by CPCRI especially for technologies pertaining to IPM, IDM etc scaling up of the same through extension programmes of State Department of Agriculture/Horticulture to improve technology uptake in coconut farming has been very limited. The potential for implementing extension/development interventions by LSGs under the decentralised planning programme for promoting effective utilisation of available technologies for enhancing productivity and income from coconut farming has also not been fully utilised. There is also a vast potential to utilise the recently formed three-tier farmer producer organisation system (of CPSs, CPFs, CPCs) facilitated by CDB for enhancing field level utilisation of coconut technologies.

Conclusion

Coconut research over the last one hundred years has yielded substantial number of technologies pertaining to agro-techniques, farming systems, pest and disease management, and value addition for enhancing yield and income from coconut farming. Though large number of technologies has been generated for the improvement of coconut and various agencies are involved in the dissemination of technologies, the extent of utilization of the available technologies in farmers' field is not at a satisfactory level. The present scenario of technology adoption calls for a paradigm shift in the technology generation and dissemination process in coconut. Ensuring farmers' participation in research and extension strengthening functional linkages among different research and extension agencies and farming community are important for enhancing technology utilisation for higher productivity and income from coconut farming.■

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CoconutFestival 2016 - Guyana

Coconut Development Board participated in Coconut Festival organized by the Government of Republic of Guyana at Arthur Chung Conference Center during 21st-23rd October 2016. Hon'ble Prime Minister of Guyana Mr. Moses Nagamootoo inaugurated the Coconut Festival on 21st October 2016. Shri. Khokan Debnath, Deputy Director, CDB, State Centre, Kolkata and Shri. B Chinnaraj, Farm Manager, DSP Farm, Kondagaon represented the Board in the Festival.

The Hon'ble Prime Minister of Guyana Mr. Moses Nagamootoo and Business Minister Mr. Dominic Gaskin visited the exhibition stall displayed by the Coconut Development Board and expressed happiness to observe the various developments of coconut industry in India.

The High commissioner of India to Guyana H.E. Mr. V. Mahalingam and Mr. S.M. Joshi, Second Secretary, High commission of India, Guyana visited the stall of Coconut Development Board at the Arthur Chung Conference Center. Different products and by-products made in India were displayed in the exhibition stall. Mr. Uron N. Salum, Executive Director, APCC also visited Board's stall. Hundreds of people from different countries visited the exhibition stall and expressed interest in the various Indian coconut products like coconut oil, packaged tender coconut water, desiccated coconut powder, coconut milk powder, coconut sugar, coconut chocolates etc. Business enquiries were received on the availability of these products in Guyana. Representatives from Surinam, Brazil, Mexico and Jamaica took part in the exhibition. Handicraft items made of coconut were also exhibited by the artisans from various counties.

A seminar was also organized as part of the programme wherein eminent scientists and technical experts made presentations on various aspects related to coconut cultivation and industry. Shri. Khokan Debnath, Deputy Director, State Centre, Kolkata made a presentation on the contemporary coconut industry in India. An article on status of coconut development in India by Dr. A.K. Singh, Chairman, Coconut development Board was given to the organizers for publishing in the Magazine to be release during the Festival.

The people of the Guyana and other neighboring countries like Surinam, Brazil, Mexico, France, Canada and other Caribbean countries visited the exhibition during the three days event and showed interest in the coconut products and by-products made in India. The High Commission of India, Georgetown, Guyana expressed his willingness to explore the possibilities of developing business relationship between India and Guyana. The exhibition helped to create visibility for Indian coconut products and by-products in the global market particularly in South & North American countries including USA and Canada.

Shri. Saradindu Das appointed Chief Coconut Development Officer, CDB

Shri.Saradindu Das took over as the Chief Coconut Development Officer of Coconut Development Board on 11th November 2016. He has been holding the post of Director at Horticulture Department, Tripura. Shri.Saradindu Das is a postgraduate in Agriculture from Bidhan Chandra Krishi Vishwa Vidyalaya, West Bengal. Shri. Das started his official career in Coconut Development Board as Technical Assistant at State Centre Kolkata in 1985. Subsequently he joined as superintendent in Agriculture Department, Tripura in 1988 and later on served as Deputy Director and Joint Director in Agriculture Department, Government of Tripura.

Dr. T.I.Mathewkutty retired

Dr. T.I.Mathewkutty, Chief Coconut Development Officer i/c, CDB retired from the service on superannuation on 31st October 2016. Dr. T.I.Mathewkutty is a post graduate in Agriculture and a PhD holder in Coconut from Kerala Agricultural University. He started his official career in Coconut Development Board on 2nd November 1982. Dr. Mathewkutty was the first Farm Manager of Mandya Demonstration cum Seed Production Farm in Karnataka. He served in various offices of the Board in different capacities at Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, and Tamil Nadu. Dr. T.I.Mathewkutty has also served as Deputy Commissioner and Additional Commissioner in the Ministry of Agriculture and Co-operation, New Delhi during 2002-2006. He has visited countries viz America, Israel and Singapore and had the opportunity to associate with coconut development activities in those areas. He is a degree holder in Law and PG Diploma holder in Journalism.

Bastar Dashera Lokutsav

Coconut Development Board, DSP Farm,Kondagaon participated in ten days exhibition in Bastar Dashera Lokutsav Jagdalpur from 03rd to 12th October 2016. Shri Dinesh Kashyap, Member of Parliament Chhattisgarh inaugurated the programme in the presence of Shri Santosh Bafna M.L.A. Jagdalpur and Shri Amit Katariya Collector, Jagdalpur.

Shri Dileep Vashnikar, Commissioner of Bastar division, Shri SRP Kaloori I.G. of Police Bastar division and Shri Amit Katariya Collector Jagdalpur visited the Board's stall.CDB, DSP Farm, Kondagaon displayed different varieties of tender coconut, coconut by products and coconut handicraft items. More than 10000 peoples visited the exhibition.

A view of the Coconut Development Board stall.

Indian Coconut products export recorded 42.15% growth

K.S. Sebastian, Assistant Director, Export Promotion, CDB.

Export of coconut products during April to October of the financial year 2016-17 touched Rs. 1206.80 crores recording a growth of 42.15% compared to the export during the corresponding period of the previous year. Significant increase was recorded in the export of desiccated coconut, coconut oil, fresh coconut, copra and coconut shell charcoal. Export of coconut products from India during April to October during the financial year 2016-17 is given in table 1.

Table1

Export of coconut products from India during April to October 2016

Sl. No.	Items	October 2015		October 2016		2015 (April to October)		2016 (April to October)	
		Qty (in MT)	Value (Rs. In lakhs)	Qty (in MT)	Value (Rs. In lakhs)	Cum. Qty (in MT)	Cum. Value (Rs. In lakhs)	Cum. Qty (in MT)	Cum.Value (Rs. In lakhs)
1	Activated Carbon	6392.24	5674.70	6354.87	6151.31	38202.46	39066.15	40132.19	40268.67
2	Coconut Oil	647.34	1402.65	7096.06	7330.49	4365.04	9957.96	23378.35	24455.54
3	Fresh coconut	2645.41	1336.66	19629.89	4264.47	19032.86	7604.01	58978.37	13815.80
4	Desiccated Coconut	137.71	261.33	1938.87	2001.18	1323.12	2015.92	9694.50	9807.73
5	Copra	427.81	359.00	1827.50	1138.52	2071.25	1844.11	13005.11	8468.85
6	Dry coconut	2423.06	2609.80	3648.28	2798.15	10939.70	11544.45	9433.80	8274.97
7	Shell charcoal	1683.20	570.36	3538.07	858.13	5469.76	1848.50	15809.39	3959.62
8	Coconut Fatty Soap		270.94		334.99		1765.59		1968.77
9	Grated/sliced coconut	314.47	441.02	118.02	235.43	1296.65	2443.01	1015.12	1884.09
10	Coconut Hair Oil				169.10				1322.92
11	Virgin Coconut Oil	83.11	233.52	68.22	192.87	573.69	1898.37	300.60	966.72
12	Oval coconut shell		100.45		76.80		564.08		724.07
13	Hair Cream		74.75		25.39		597.88		288.85
14	Coconut Water		96.36		34.41		468.13		277.42
15	Misc coconut products		823.97		627.47		3278.25		4196.09
	Total		14255.52		26238.71		84896.41		120680.10

Activated Carbon

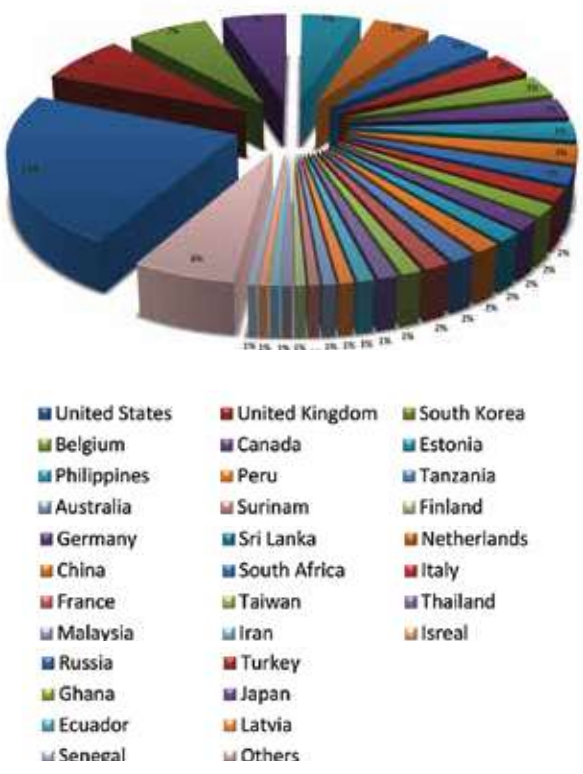
The export of activated carbon from India during April to October 2016 was 40,132.19 MT. United States was the leading importer of Indian Activated Carbon, followed by United Kingdom. Details of export of Activated Carbon from India during April to September 2016 is given in table 2

Country	Quantity (in MT)	Value (Rs in lakhs)
United States	9094.06	9084.76
United Kingdom	2890.03	2848.63
South Korea	2683.39	2990.14
Germany	2132.05	2147.94
Sri Lanka	1985.88	1737.27
Netherlands	1907.26	1931.57
Russia	1870.54	1853.18
Turkey	1450.83	1171.46
Belgium	1264.81	1203.55
Canada	1160.12	1161.08

Estonia	1118.00	1088.37
China	1073.63	1438.60
South Africa	968.05	963.78
Italy	773.60	649.77
Ghana	707.40	784.08
Japan	651.94	860.16
Philippines	626.97	645.16
Peru	621.80	546.94
Tanzania	617.40	666.88
France	606.05	667.76
Taiwan	487.90	460.85
Thailand	476.21	475.90
Ecuador	399.00	393.72
Latvia	344.00	343.15
Australia	315.50	310.07
Surinam	264.00	269.50
Finland	262.60	181.50
Malaysia	238.15	267.74
Iran	222.20	227.18
Isreal	213.62	189.92
Senegal	202.40	224.73
Others	2502.80	2483.33
Total	40132.19	40268.67

Table 2

(quantity in %)



Coconut Oil

Export of coconut oil from India during April to October of the financial year 2016-17 was 23378.35 MT, which was 435.58% higher compared to 4365.04 MT recorded during the corresponding period of last year.

Malaysia, Indonesia, UAE, Sri Lanka, Myanmar and Saudi Arabia are the major countries exporting coconut oil from India. Export of coconut oil from India during the month of April to September 2016 is given in table 3.

(quantity in %)

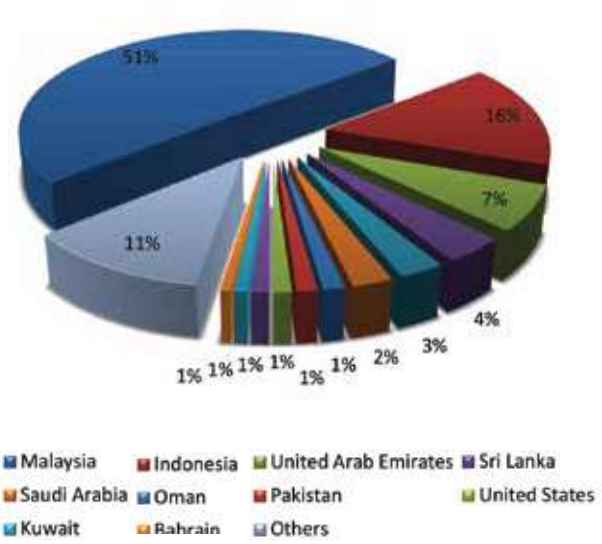


Table 3

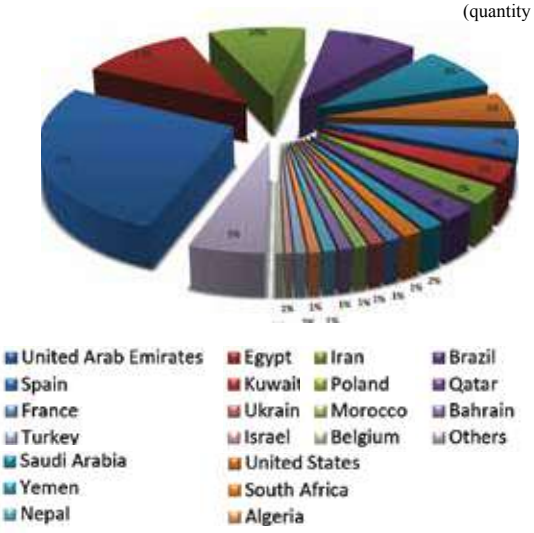
Export of coconut oil during April to October 2016		
Country	Quantity (in MT)	Value (Rs in lakhs)
Malaysia	11808.90	11031.01
Indonesia	3745.78	3332.40
United Arab Emirates	1596.98	2074.88
Sri Lanka	907.40	929.44
Myanmar	650.80	783.29
Saudi Arabia	578.38	753.71
Oman	305.10	375.05
Pakistan	289.69	462.80
United States	250.66	599.32
Qatar	246.03	362.85
Kuwait	183.67	238.11
Bahrain	142.14	196.57
Others	2672.82	3316.12
Total	23378.35	24455.54

Desiccated Coconut : Export of desiccated coconut during April to October of the financial year 2016-17 was 9694.50 MT which was 632.70 % more than the desiccated coconut export during the corresponding period of last year. Export of desiccated coconut during the corresponding period of the previous year was 1323.12 MT. Country wise export of desiccated coconut powder during the period April to October 2016 is given in table 4.

Table 4

Export of DC from India during April to October 2016		
Country	Quantity(in MT)	Value(Rs in lakhs)
United Arab Emirates	2593.99	2578.26
Egypt	1075.00	1041.11
Iran	945.00	961.86
Brazil	888.00	953.01
Saudi Arabia	795.24	815.42
United States	531.32	526.92
Spain	483.00	476.15
Kuwait	316.86	336.80
Poland	287.00	291.75
Qatar	257.37	265.55
Yemen	151.42	149.16
South Africa	137.00	139.28
France	102.00	113.49
Ukraine	96.00	99.93
Morocco	89.00	90.70
Bahrain	87.32	95.55
Nepal	86.34	94.50
Algeria	77.00	75.79
Turkey	75.00	60.03
Israel	51.00	54.50
Belgium	50.00	53.99
Others	519.65	533.98
Total	9694.50	9807.73

(quantity in %)



Fresh Coconut

Export of dehusked coconut from India during the period April to October 2016 was 58978.37 MT. Export of fresh coconut during the corresponding period of last year was only 19032.86 MT.Countrywise export of fresh coconut from India during this period is given in table 5.

Export of fresh coconut during April to October 2016		
Country	Quantity (in MT)	Value (Rs in lakhs)
China	22296.74	4325.91
United Arab Emirates	16844.08	4678.52
Iran	2707.97	792.79
United Kingdom	2475.04	850.70
Domenican Republic	2285.34	564.11
Oman	1387.90	442.62
Bahrain	1263.83	349.74
Kuwait	1001.53	312.84
Qatar	720.15	254.39
Mauritius	631.63	180.93
Saudi Arabia	539.71	232.18
Spain	499.10	232.96
Singapore	384.68	89.92
Others	5940.68	508.19
Total	58978.37	13815.80

Table 5

(quantity in %)

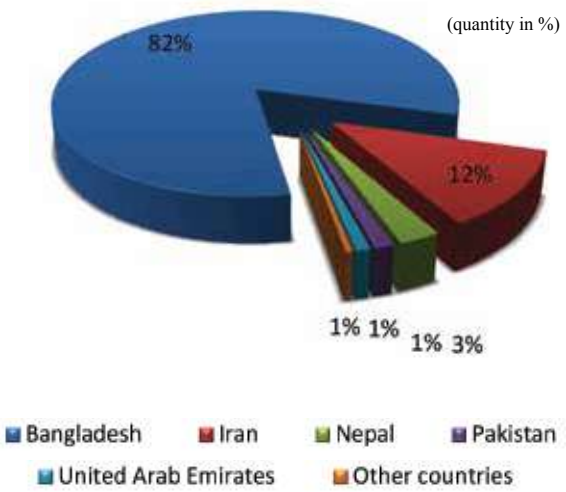
Copra

Export of copra from India from April to October 2016 was 13,005.11 MT against export of 2071.25 MT recorded during the corresponding period of previous year. Countrywise export of copra from India during the period is given in table 6.

Table 6

Export of Copra during April to October 2016		
Country	Quantity (in MT)	Value (Rs in lakhs)
Bangladesh	10682.32	6920.27
Iran	1617.05	1017.10
Nepal	353.88	272.03
Pakistan	164.00	105.01
United Arab Emirates	125.00	79.64
Other countries	62.87	74.80
Total	13005.11	8468.85

(quantity in %)



Coconut Shell Charcoal

Export of coconut shell charcoal from India during April to October of the financial year 2016-17 was 15,809.39MT which is 189.03% higher than the export during the corresponding period of the previous year. The export of coconut shell charcoal during the corresponding period of the previous year was 5469.76 MT only. Since the domestic price of coconut shell charcoal is very competitive and the product is covered under Merchandise Export Incentive Scheme (MEIS), the export is expected to increase in the coming months also. Countrywise export of coconut shell charcoal during the period is given in table 7.

(quantity in %)

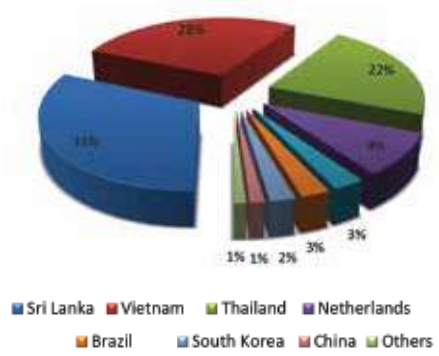


Table 7

Export of Coconut shell charcoal during April to October 2016		
Country	Quantity (in MT)	Value (Rs in lakhs)
Sri Lanka	4981.78	1270.30
Vietnam	4363.80	1004.24
Thailand	3472.00	766.45
Netherlands	1438.90	467.30
Mexico	440.00	141.77
Brazil	399.00	87.87
South Korea	351.00	104.26
China	199.00	47.57
Others	163.91	69.84
Total	15809.39	3959.62

During the first six months of the financial year 2016-17, India imported Rs. 248.90 crores worth coconut products. Copra expeller cake and coconut fatty acid were the major items imported during this period. Details of import of coconut products into India during the period from April to October 2016 is given in table 8.

Import of coconut products to India during the period April to September 2016								
Item	September 2015		September 2016		April to September 2015		April to September 2016	
	Quantity (in MT)	Value (Rs. In lakhs)	Quantity (in MT)	Value (Rs. In lakhs)	Cum. Quantity (in MT)	Cum. Value (Rs. In lakhs)	Cum. Quantity (in MT)	Cum. Value (Rs. In lakhs)
Copra oil cake	19330.28	2922.41	11564.81	1944.88	74035.94	11604.38	100982.17	16447.79
Coconut fatty acid	618.66	432.78	602.71	632.59	4711.21	3746.21	5910.72	5666.49
Coconut Cream-milk-powder		149.03		246.08		785.48		1642.10
Coconut shell charcoal	1176.24	383.05	17.72	2.43	10225.90	3216.37	344.11	99.30
coconut oil	651.24	467.28	0.18	0.89	3964.93	3262.53	5.01	18.83
Copra	0.00	0.00	0.00	0.00	170.27	126.21	0.00	0.00
Misc coconut products		89.74		262.15		839.60		1015.39
Total		4444.30		3089.02		23580.77		24889.90

Table 8

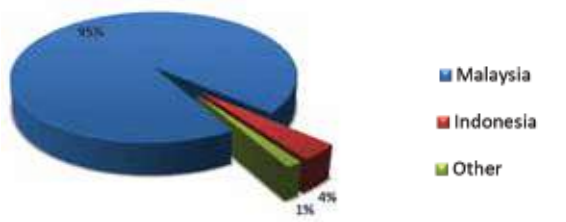
Coconut Fatty Acid

Import of coconut fatty acid into India during April to October of the financial year 2016-17 was 5910.72 MT, out of which 5591.78 MT was from Malaysia. Import of coconut fatty acid during the corresponding period of last year was 4711.21 MT. Details of import of coconut fatty acid to india from April to October 2016 is given in table 9.

Table 9

Import of coconut fatty acid during April to October 2016		
Country	Qty (in MT)	Value (Rs. In lakhs)
Malaysia	5591.78	5383.60
Indonesia	228.20	194.20
Other	90.74	88.70
Total	5910.72	5666.49

(quantity in %)



Copra expeller cake

In terms of quantity and value, copra expeller cake is the major coconut product imported to India. During April to October of the financial year 2016-17, the quantity of import of this product was 100982.17 MT of which 49600.00 MT was from Indonesia. Details of import during the period April to October 2016 is given in table 10.

(quantity in %)

Table 10

Import of coconutoil cake during April to October 2016		
Country	Qty (in MT)	Value (Rs. In lakhs)
Indonesia	49600.00	7589.71
Philippines	38600.00	6497.26
Sri Lanka	10865.55	2024.35
Papua New Guinea	1529.27	274.34
Others	387.35	62.13
Total	100982.17	16447.79

Market review – October 2016

Domestic price

Coconut Oil

The price of coconut oil in Kochi, Alappuzha and Kozhikode market expressed a slight upward trend by the end of October. The prices showed a downward trend during the first week of October and during the second week and 3rd week the prices expressed a steady trend. In the last week the prices expressed a slight upward trend. The monthly average price of coconut oil at Kochi market was Rs.9775 per quintal and at Alappuzha market was Rs.9761 during the month of October. At Kozhikode market the monthly average price of coconut oil was Rs.10429 per quintal. But at Kangeyam market in Tamil Nadu, fluctuations in price was more pronounced with a monthly average of Rs.8856 per quintal.

Table1: Weekly average of price of coconut oil at major markets Rs/Quintal)

	Kochi	Alappuzha	Kozhikode	Kangayam
02.10.2016	9800	9800	10500	8933
09.10.2016	9733	9750	10433	8800
16.10.2016	9700	9700	10400	8789
23.10.2016	9700	9700	10400	8811
31.10.2016	9925	9858	10457	8990
Average	9775	9761	10429	8856

The prices at Kochi, Alappuzha and Kozhikode markets were marginally higher than that of the previous month and 8-12 percent lower than the prices prevailed in October 2015.

Milling copra

The price of milling copra at major markets moved in tune with the prices of coconut oil. The price expressed a downward trend during the first week and remained steady during the second and third week. The price closed with a slight upward trend in all three markets. At Kochi market, the monthly average price of FAQ copra was Rs.6407 per quintal. The monthly average price of copra at Alappuzha market was Rs.6291 per quintal and at Kozhikode market was Rs.6398 per quintal. The price at Kochi, Alappuzha and Kozhikode markets were marginally more than that of the previous month and 13-15 percent lower than the prices prevailed in October 2015.

At Kangayam Market in Tamil Nadu, fluctuation in the price was more pronounced. The monthly average price was Rs.6112 per quintal which was marginally more than the previous month and 15 percent lower than the corresponding month last year.

Table2: Weekly average price of Milling Copra at major markets (Rs/Quintal)

	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan-gayam
02.10.2016	6400	6300	6350	6100
09.10.2016	6367	6275	6367	6075
16.10.2016	6350	6250	6388	6092
23.10.2016	6350	6250	6375	6067
31.10.2016	6533	6367	6457	6200
Average	6407	6291	6398	6112

Edible copra

The price of Rajapur copra at Kozhikode market also expressed a fluctuating trend during the month. The monthly average price of Rs.7883 per quintal was 47 percent lower compared to the price prevailed in the corresponding month last year.

Table3 :Weekly average of price of edible copra at Kozhikode market (Rs/Quintal)	
02.10.2016	7900
09.10.2016	7942
16.10.2016	8213
23.10.2016	7992
31.10.2016	7550
Average	7883

Ball copra

The price of ball copra at Tiptur market expressed a fluctuating trend. The monthly average price of ball copra at this market was Rs.6618 per quintal which was 5 percent lower compared to previous month price and 44 percent lower compared to the price prevailed in October 2015.

At Arsikere APMC market in Karnataka, the monthly average price of ball copra was Rs.6514 per quintal. This was 6 percent lower compared to the previous month's average price and 36 percent lower compared to the price prevailed in October 2015.

Table 4 : Weekly average of price of Ball copra at major markets in Karnataka (Rs/Quintal)		
	Tiptur	Arsikere
02.10.2016	6800	NA
09.10.2016	6757	6582
16.10.2016	6675	6566
23.10.2016	6550	6509
31.10.2016	6440	6426
Average	6618	6514

Dry coconut

At Kozhikode market the price of dry coconut expressed a slight upward trend during the month. The monthly average price of Rs.5517 per quintal was 4 percent higher compared to the previous month and 41 percent lower compared to the previous year price.

Table5 : Weekly average of price of Dry Coconut at Kozhikode market (Rs/1000 coconuts)	
02.10.2016	5100
09.10.2016	4650
16.10.2016	4600
23.10.2016	5333
31.10.2016	7000
Average	5517

Coconut

The price of coconut at Nedumangad market remained same at Rs.9000 per thousand nuts throughout the month which was 15 percent lower compared to the price prevalent in October 2015.

The market price of partially dehusked coconut at Arisikere market expressed a slight fluctuating trend during the month. The monthly average price at this market was Rs.8262 per thousand nuts.

At Bangalore APMC the monthly average price of partially dehusked coconut was Rs.8194 per thousand nuts which was 7 percent higher than that of the previous month and about 49 percent lower than that of the corresponding month last year.

At Manglore APMC market the monthly average price of partially dehusked coconut was at this market at Rs.14250 per thousand nuts. It was 8 percent higher than that of the previous month and about 9 percent lower than that of the corresponding month last year.

Table 6: Weekly average of price of coconut at major markets (Rs /1000 coconuts)				
	Nedumangad	Arsikere	Banglore	Mangalore (Grade-1)
02.10.2016	9000	8800	8500	13500
09.10.2016	9000	9550	8500	14000
16.10.2016	9000	9700	8500	14000
23.10.2016	9000	7506	8250	14500
31.10.2016	9000	7575	7500	14500
Average	9000	8262	8194	14250

Tender coconut

The price of tender coconut at Maddur market expressed a slight fluctuating trend during the month. The monthly average price of tender coconut at Maddur APMC market in Karnataka was Rs.9880 per thousand nuts, which was marginally higher compared to the previous month price and 2 percent lower than that of the price prevailed during the corresponding month last year.

Table7 : Weekly average of price of tender coconut at Maddur market (Rs/1000 coconuts)	
02.10.2016	10000
09.10.2016	10000
16.10.2016	9500
23.10.2016	10000
31.10.2016	10000
Average	9880

International price

Coconut oil

The price of coconut oil at Europe and Indonesia and Philippines expressed a slight fluctuating trend during the month. Price of coconut oil at all markets expressed a slight upward trend by the end of the month.The domestic price of coconut oil opened at US$ 1464 and closed at 1480 per MT in India. The price of coconut oil quoted at different international markets is given below.

Table 8: Weekly average Price coconut oil in major coconut oil producing countries October 2016				
	International Price(US$/MT)	Domestic Price(US$/MT)		
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia Indonesia	India*
07.10.2016	1482	1467	1423	1464
14.10.2016	1435	1413	1403	1452
21.10.2016	1480	1397	1448	1452
28.10.2016	1500	1429	1469	1480
Average	1474	1426	1435	1462
* Kochi Market				

Copra

Price of copra in Philippines and Srilanka expressed a slight downward trend during the month. Whereas the price of copra in India and Indonesia expressed a fluctuating trend during the month. Price of copra in Srilanka was the highest among all the major copra producing countries.

Table 9: Weekly average Price of copra in major copra producing countries October 2016				
	Domestic Price(US$/MT)			
	Philippines	Indonesia	Srilanka	India*
07.10.2016	883	891	1300	957
14.10.2016	873	866	1295	951
21.10.2016	862	881	1295	951
28.10.2016	864	881	1295	974
Average	871	880	1296	958
* Kochi Market				

Desiccated coconut

The FOB price of desiccated coconut in India during the month of October was very competitive compared to the prices of major DC exporting countries. Price of desiccated coconut in Philippines market appears to be much higher than the other major desiccated coconut manufacturing countries.

Table 10: Weekly average price of desiccated coconut in October 2016

	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
07.10.2016	2431	2080	2146	1536
14.10.2016	2431	2100	2208	1495
21.10.2016	2414	2100	2187	1610
28.10.2016	2387	2075	2282	1542
Average	2415	2089	2206	1546

*FOB

Coconut

The price of dehusked coconut in Srilanka, Philippines and Indonesia showed a fluctuating trend during the month. In India, the price of coconut expressed a slight decline by the end of the month. The domestic price of dehusked coconut in India was slightly higher compared to other major coconut producing countries.

Table 11: Weekly average price of dehusked coconut with water during October 2016

Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
07.10.2016	206	222	200	253
14.10.2016	208	219	200	255
21.10.2016	205	219	202	263
28.10.2016	206	222	201	262
Average	206	221	201	258

*Pollachi market

Coconut shell charcoal

The FOB price of coconut shell charcoal in India expressed a slight fluctuating trend during the month. Philippines quoted the lowest price. Whereas Srilanka's price was the highest among major coconut shell charcoal exporting countries.

Table 12: Weekly average price of coconut shell charcoal during October 2016

Date	Domestic Price(US$/MT)			
	Philippines	Indonesia	Srilanka	India
07.10.2016	373	380	440	385
14.10.2016	340	390	436	355
21.10.2016	340	390	436	349
28.10.2016	340	390	432	358
Average	348	388	436	362

*FOB

Monthly operations in coconut garden -December

Andaman & Nicobar Islands: Pile up soil into mounds in sandy and loamy soils. Hoe or plough in other types of soils.

Andhra Pradesh: Spray young seedlings affected with black-headed caterpillar (Opisina arenosella) with 0.05 per cent malathion or phosalone or 0.02 percent dichlorvos on the lower side of the leaves. Release stage specific parasites like Bethylid, (Goniozus nephantidis) for 3rd larval stage and Chalcidid (Brachymeria nosatoi) for early pupal stage. Larval parasitoid Braconid (Bracon hebetor) an pupal parasitoid Ichneumonid (Xanthopimpla punctata) can also be used as promising parasitoids. In multistage condition of the pest, combined release of all the parasitoids is required. When an initial insecticide treatment is given the parasitoids may be released only after three weeks of spraying. Treat red palm weevil affected palms by injecting 0.1 per cent dichlorvos or one per cent carbaryl. Depending on the intensity of pest infestation about 1-1.5 litres of insecticide suspension may be required for one palm. In the case of crown damage, the damaged tissues have to be removed and the insecticide suspension may be poured in. When pest entry is through the trunk all the holes on the stem may be plugged with cement or plaster of paris to avoid further damage of the tree from the pest attack. Harvest cowpea, raised as an inter crop in

coconut garden. Plough the land and leave it fallow.

Assam: Irrigate the garden. Collect seednuts from selected mother palms and store them in shade in a cool, dry place. If rat damage is noticed organize a planned group action in the whole locality covering the residential houses and surrounding crop field including coconut and other horticultural gardens. Use poison baits, traps, etc. against rats. Fixing rat cones made of tin sheets on the trunk at a height of 2m above the ground will prevent the entry of rats on the palm. Clean the crowns of the palms periodically.

Bihar / Madhya Pradesh/ Chhattisgarh: Start irrigation depending upon the need. Keep the newly planted pits and basins of the palms weed free and remove the soil from collar region of the seedling. Protect young palms from winter scorching by providing suitable shade. Raise winter vegetable suited to the locality. Apply blitox @ 5g/ litre or dithane M-45 @ 2g/litre at the crown and bunches alternatively to avoid secondary infections due to cold injury and continue upto February. Check the palms for termite attack. Drench the soil with 0.05 percent chlorpyriphos twice at 20 to 25 days interval. The affected trunk may be swabbed with the above chemical. Do not cut the green leaves and other living plant parts.

Karnataka: Irrigate young seedlings. Keep the nursery free of weeds and continue discarding of poor seedlings. If the attack of the mite is noticed, spray neem oil - garlic – soap emulsion 2 percent (20 ml neem oil + 20 gm garlic emulsion + 5 gm soap in 1 litre water) or azadiractin 1 per cent @4ml per litre or root feed azadiractin 5 per cent @ 7.5 ml with equal quantity of water. Collection of seednut from selected mother palm may be continued.

Kerala/Lakshadweep: Mother palms may be selected during the month for the collection of seednuts. Level down the mounds piled up earlier in the coconut garden. If the garden soil is sandy, add clay and if it is clayey add sand around the palms to improve the soil structure. Clear the irrigation channels. Clean the crowns of the palms periodically. Shade the newly planted and young seedlings. Apply sevidol 8G (25g) + fine sand (200 g) per palm in the top most 2-3 leaf axils against rhinoceros beetle and red palm weevil. Apply one-fourth of the recommended dose of fertilisers in the irrigated gardens. If mite infestation is noticed clean the crowns of the palms and spray neem oil - garlic – soap emulsion 2 percent (20 ml neem oil + 20 gm garlic emulsion + 5 gm soap in 1 litre water) or azadiractin @4ml per litre or root feed @ 7.5 ml with equal quantity of water.

Maharashtra/Goa/Gujarat: Plant yams as intercrop in the pits of 75 cm diameter and 15 cm depth spaced 100 cm apart. Before planting, fill the pits with farm waste and burn them. Level down the mounds piled up earlier in the garden.

Mother palm

Orissa: Seasonal intercrops may be sown. Irrigate coconut and the intercrops. Incorporate green manure. Coconut basins may be mulched with coir pith/ husk etc.

Plant protection chemicals may be applied according to the pest/ disease. If the attack of eriophyid mite is noticed root feed azadirachtin 5 per cent @7.5 ml with equal quantity of water. Clean the crown. Continue other maintenance operations to the intercrops as well as coconut.

Tamil Nadu/Puducherry: Treat all manure pits with carbaryl 50wp @ 0.01 per cent to destroy the grubs of rhinoceros beetle. Start irrigating the young seedlings. Keep the nursery free of weeds and continue discarding poor seedlings. Select mother palms for seednut collection. In areas where mite infestation is noticed, spray neem oil - garlic – soap emulsion 2 percent (20 ml neem oil + 20 gm garlic emulsion + 5 gm soap in 1 litre water) or azadiractin 1 per cent @ 4ml per litre especially on the perianth region of buttons and affected nuts or root feed azadiractin 5 per cent @ 7.5 ml with equal quantity of water.

Tripura: Irrigate the palms. Mother palms may be selected during the month for collection of seednuts for next year. Partial shade should be provided in south-west direction to the newly planted seedlings to prevent scorching.

West Bengal: Start harvesting of nuts. Treat the manure pit. Keep the nursery free from weeds. Continue discarding of poor seedlings. Irrigate the nursery once in a week. ■