Scientist-farmer interface on effective use of technologies for productivity improvement

Thamban, C., Jaganathan, D. and Muralidharan, K.,
ICAR- Central Plantation Crops Research Institute, Kasaragod

Coconut, the versatile tree crop, significantly influences rural economy of our country by supporting the livelihoods of millions of people. Focused research over the last one hundred years has resulted in substantial number of technologies for enhancing yield and income from coconut farming. However, coconut growers experience myriad of problems to effectively utilise these technologies to make farming remunerative. Low efficacy of transfer of technology and feedback system due to the lack of effective mechanism to ensure proper functional linkages among various stakeholders in coconut sector including researchers, extension personnel and farmers is one of the factors limiting effective use of technologies in coconut farming. ICAR-Central Plantation Crops Research Institute (CPCRI), the premier coconut research organisation, has been implementing various front line extension activities for the dissemination of research results to farmers and other stakeholders and the thrust of such initiatives is on farmer participatory technology transfer approaches.

Interactive videoconferencing to facilitate Scientist-Farmer Interface programmes

Facilitating scientist-farmer interface programmes to interact on available technologies and experiences of coconut farmers in the farm level adoption of technologies is an important technology transfer activity of CPCRI. Interactive videoconferencing has been used by the institute for organising Research-Extension -Farmer interface programmes on coconut

farming since the year 2007. This facility provides more opportunities for the researchers at the Institute to have interactions on field problems with farmers and other stakeholders located in distant places. The interactive videoconferencing programmes employ different modes of interaction between the participants. Scientist-Farmer interface mostly utilize question-answer mode at times supported by use of power point presentation followed by discussion.

Scientist-Farmer Interface programme through videoconferencing on 'Coconut cultivation practices and coconut value addition' was organised by ICAR-CPCRI during May 2017 at CDB, Kochi. During the interface, scientists at CPCRI Kasaragod and 69 selected coconut farmers and entrepreneurs representing different Coconut Producer Societies/ Federations/Companies from Ernakulam,

Improved varieties of coconut released by CPCRI	
Variety	**Area for which recommended**
Tall varieties	
Chandra Kalpa	Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra
Kera Chandra	Kerala, Karnataka, Konkan region, Andhra Pradesh, West Bengal
Kalpatharu	Kerala, Karnataka, Tamil Nadu
Kalpa Pratibha	West Coast region, Peninsular India
Kalpa Dhenu	West Coast region, Tamil Nadu & Andaman &Nicobar Islands
Kalpa Mitra	West Coast region & West Bengal
Kalpa Haritha	Kerala, Karnataka
Dwarf varieties	
Chowghat Orange Dwarf	All coconut growing areas
Kalpasree	Root (wilt) disease prevalent tracts
Kalparaksha	Kerala & Root (wilt) disease prevalent tracts
Kalpa surya	Kerala, Karnataka, Tamilnadu
Kalpa Jyothi	Kerala, Karnataka, Assam
Hybrid varieties	
Chandra Sankara (COD x WCT)	Kerala, Karnataka, Tamil Nadu
Kera Sankara (WCT x COD)	Kerala, Karnataka, Maharashtra, Andhra Pradesh
Chandra Laksha (LCT x COD)	Kerala, Karnataka
Kalpa Samrudhi (MYD x WCT)	Kerala, Assam
Kalpa Sankara (CGD x WCT)	Root (wilt) disease prevalent tracts
Kalpa Sreshta (MYD X TPT)	Kerala, Karnataka

Interactive video conferencing at CDB Kochi

Thrissur and nearby districts of Kerala state at Coconut Development Board office, Kochi interacted on various aspects of scientific coconut farming and value addition. Dr. P. Chowdappa, Director, CPCRI formally inaugurated the interface programme. In his brief inaugural address, Dr. P. Chowdappa highlighted the importance of ensuring coordination between the Coconut Producer Companies functioning in different parts of the country so that the production and marketing of value added coconut products can be streamlined in a mutually benefitting and efficient manner. He also emphasized the need for utilizing the organisationsal platforms of Coconut Producer Societies/Federations/Companies for facilitating technology transfer initiatives on scientific coconut farming and value addition with the support of coconut research and development organizations and extension agencies.

Dr. K. Samsudeen, Principal Scientist, Dr. P. S. Prathibha, Scientist, Dr. V. Selvamani, Scientist, Dr. P. P. Shameena Beegum, Scientist, Dr. D. Jaganathan, Scientist and Dr. C. Thamban, Head Social Sciences Division participated in the interface programme at CPCRI, Kasaragod. Dr. K. Muralidharan, Principal Scientist coordinated the programme at CDB, Kochi.

Thematic areas of interface programme

The broad thematic areas related to coconut cultivation and value addition on which farmers sought information from scientists during the interface programme included the following:

i) Which are the improved coconut varieties, especially dwarf varieties, recommended for cultivation? Often coconut farmers experience difficulties in obtaining required number of seedlings of improved coconut varieties. What can be done to improve the situation on planting material availability in coconut?

A large number of improved varieties of coconut have been released for cultivation which include tall, dwarf and hybrid varieties which have high yield potential and other desirable traits.

Hybrids will perform better in well managed conditions, especially with balanced fertilizer application and irrigation. Dwarf varieties of coconut are suitable for mostly tender coconut purpose. They are also used for production of hybrid coconut seedlings. Compared to dwarf varieties, tall and hybrid varieties are suitable for extraction of neera (coconut inflorescence sap). Dwarf varieties are not suitable for copra production.

The farmers participatied in the interface opined lack of availability of quality seedlings as a major constraint to adoption of improved coconut varieties. For a sustainable growth of coconut sector it is recommended to have tall, dwarf and hybrid varieties cultivated in the ratio of 60:20:20. However, the field level scenario indicates a different story; tall cultivars constitute more than 90 per cent of coconut palm population. Predominance of senile and unproductive genetically inferior local tall palm population is a major constraint in improving productivity of coconut in major coconut growing tracts like Kerala. In Kerala on an average 28-30 lakh coconut seedlings are required annually. But on an average the State Department of Agriculture, the major agency involved in coconut seedling distribution in the state, can supply only about 6-7 lakh seedlings which include mostly the West Coast Tall variety (WCT) and limited number of dwarf and hybrid seedlings, revealing a huge gap between demand and supply. Unscrupulous elements have been hugely benefitted by the situation who supplies inferior/spurious planting materials to farmers thus adversely affecting sustainable growth of coconut sector. Since most of the existing seed gardens in Kerala 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.

Utilisation of superior genetic resources of coconut available in farmers' gardens is the most important short term strategy to meet the demand for coconut seedlings. Farmer participatory seedling production initiatives are to be promoted to meet the planting material requirement utilizing the locally available

> Utilisation of superior genetic resources of coconut available in farmers' gardens is the most important short term strategy to meet the demand for coconut seedlings.

resources/mother palms. However, it has to be ensured that utmost care is taken to locate and identify the superior mother palms of locally adapted coconut varieties in farmer's garden. Coconut Producers' Societies (CPS), the grass root level collective of coconut growers facilitated by Coconut Development Board, and trained youths under the Friends of Coconut Trees (FoCT) programme can play a significant role in the decentralised production and distribution of quality hybrid coconut seedlings. The process can be technically supported by research organisations such as CPCRI.

Decentralized approach for enhancing production of seedlings of improved varieties should be promoted by establishing more number of nucleus seed gardens. Such seed gardens may be encouraged in marginal and small farmer holdings. Public sector agencies including Coconut Development Board and State Department of Agriculture are having programmes for procuring seednuts from farmers' gardens. Recently in Kerala, State Department of Agriculture has implemented 'Kerasamrudhi' scheme which envisaged identifying mother palms of dwarf coconut varieties in farmers' garden and collecting seednuts. To ensure quality of planting material the criteria fixed for identification of mother palms have to be scrupulously followed in decentralized initiatives and pressure to achieve the physical target should in no way dilute the scientific procedures to be followed in selecting mother palms. To augment seedling production in the root (wilt) disease prevalent tract, selection and identification of disease-free mother palms in 'disease hotspots' should be given more emphasis rather than large scale procurement of seed nuts from other areas.

ii) Low price of coconut/market fluctuation is a major problem experienced by coconut farmers. How coconut based multiple cropping/integrated farming can be popularized as a strategy to make coconut farming economically viable under such a situation?

Systematic coconut based cropping/farming system is an important strategy to make coconut farming economically viable in small holdings. This strategy is highly relevant in the present day context since currently coconut farmers are more exposed to economic risks and uncertainties owing to the high degree of price fluctuations. In spite of the obvious benefits of coconut based farming system over the traditional monoculture, the extent of adoption of the recommended cropping/farming systems is not at a satisfactory level. However, there are cases of farmers who are highly successful in field implementation of multiple cropping/integrated farming in coconut. Similarly, some grama panchayats also have successfully implemented interventions related to coconut based farming system under the peoples' campaign for decentralized planning programme. The potential for strengthening food and nutritional security through the adoption of appropriate coconut based intercropping/mixed farming also need to be effectively utilized.

Inter/ mixed crops are to be selected based on the age of the palms, size of the crown and availability of sunlight in the garden. A variety of inter crops like pineapple, banana, elephant foot yam, groundnut, chillies, sweet potato and tapioca can be raised in coconut gardens upto 8 -10 years. During the second growth phase of palms, i.e., 10 to 22 years of age, growing of other crops in the interspace may be difficult due to poor sunlight availability. However, crops like colocasia, some varieties of banana like palayamkodan etc. which can tolerate shade can be cultivated in this phase. After the palms attain a height of 5 to 6 metres (above 22 years) i.e., in older plantations, perennials like cocoa, pepper, cinnamon, clove and nutmeg can be grown as mixed crops along with the intercrops. In places where rainfall is not well distributed, irrigation is necessary during summer months. However, these crops are to be adequately and separately manured in addition to the manures applied to coconut palms. Mixed farming by raising fodder grasses such as hybrid Napier or guinea grass along with leguminous fodder crops such as Stylosanthes gracilis in coconut gardens has been found to be profitable. Raising the above crops in one hectare of coconut garden can support four to five dairy animals. In addition to the cattle, poultry, pisiculture and apiculture may be integrated depending upon the farmers interest. The cattle and poultry manure generated from the system when applied to coconut garden improves the soil fertility considerably. Maintaining milch cows and other components in coconut garden helps the

farmer to enhance his income and provide additional employment to the family.

The experiences of CPCRI in facilitating Community Based Organisations of small and marginal coconut growers under different research projects including the IPGRI-COGENT project on 'Developing sustainable coconut based income generating technologies in poor rural communities' and National Agricultural Innovation Project (NAIP) sub-project on 'Value chain in coconut' has clearly demonstrated that adoption of coconut based cropping/farming systems is an effective strategy for enhancing productivity and income. Appropriate schemes are to be implemented by agencies like Coconut Development Board, State Department of Agriculture and Local Self Governments for popularising coconut based cropping/farming systems. Coconut Producers' Societies/Federations can facilitate implementation of such schemes at the grass root level.

iii) Productivity of many coconut gardens is on the decline. What are the major reasons for the low productivity and how productivity can be enhanced?

Various reasons can be attributed to the low productivity of coconut. One of the major reasons is low level of adoption of crop management practices including nutrient management, irrigation and water management. Hence, it is important to implement programmes based on a strategy for promoting interventions to ensure adequate care and management of coconut palms in the existing gardens to enhance productivity.

The study funded by Kerala State Planning Board on fertility of soils of Kerala has revealed that soil related constraints viz., very strong soil acidity, extensive deficiency of secondary nutrients calcium and magnesium and wide spread deficiency of micro-nutrient boron are among the important factors for low productivity of coconut in the state. In this background a project supported by State Planning Board for demonstrating the efficacy of Best Management Practices including site specific nutrient management based on soil and plant analysis data for enhancing productivity of coconut is being implemented in 60 selected coconut gardens in six agro-ecological units located in six districts in Kerala state @10 gardens per location since the last two years. An innovative extension service delivery model has been initiated in the project area with special emphasis on promoting soil health management practices evolved to address the soil related constraints for enhancing productivity and income from coconut farming in different agro-ecological units. The model assimilates the socio-economic realities while addressing the lacunae in the existing models of extension strategies. The rising share of non-farm income sources, shifts in demographic pattern affecting availability of family labour and hired labour, inefficiencies in input delivery system, predominance of small holder producers, etc. were found to influence the production effort and consequently, technology adoption. The extension approach adopted involved restructuring of crop management practices and concurrent monitoring to address the low level of management inputs and the constraints arising out of changes in agrarian structure. The initial results of interventions under the project indicate the scope for enhancing the economic viability of coconut based land use systems through the innovative approach. It is also worthwhile to explore the potential for scaling up of interventions through Agricultural Technology Management Agency (ATMA), State Department of Agriculture and Local Self Government initiatives. Simple technology for vermicomposting of coconut leaves as part of on farm organic matter recycling in coconut gardens is very relevant in the context of growing awareness about organic farming/eco-friendly farming in Kerala.

Rainfed cultivation of coconut is another important reason for low productivity in Kerala. Water scarcity experienced by the palms during summer from December to May months adversely affects coconut production. The problem is more severe in northern Kerala where rainfall distribution is highly skewed. In water scarce areas drip irrigation is to be promoted to irrigate coconut palms to achieve higher water use efficiency. If there is drip irrigation facility, then the water soluble fertilizers can be applied to coconut palms along with drip irrigation (fertigation) for higher fertilizer use efficiency. Adoption of soil and water conservation measures in coconut gardens

enhances coconut productivity. Analysis of impact of technological interventions under Farmers Participatory Action Research Programme (FPARP) implemented by CPCRI in coconut gardens in farmers' field revealed the efficacy of soil and water conservation technologies for water saving/water use efficiency, yield enhancement in crops and enhancing cropping intensity. The activities under FPARP also led to enhancement in knowledge about soil and water conservation measures and level of participation of farmers in implementing soil and water conservation interventions. The interventions also revealed the potential for scaling up these technologies in farm holdings in the west coast region having coconut based cropping systems with agroclimatic situation similar to the project area. Coconut Producers' Societies/Federations can facilitate formulation and implementation of watershed based development schemes at the grass root level with the support of relevant development agencies so that coconut gardens covered under the watershed area get benefitted by way of implementing soil and water conservation measures for enhancing coconut productivity.

iv) Product diversification is suggested as an important strategy to enhance income from coconut farming and virgin coconut oil is getting popular as a value added product. What are the technologies for virgin coconut oil production? Is there any quality standard fixed for VCO? Similarly opportunity for the production and marketing of neera has raised lot of expectation among coconut growers. However, coconut producer federations involved in the neera production are facing lot of technological/marketing problems. How to overcome these problems?

To cope with the market fluctuations, there is a need for product diversification and byproduct utilization. Hence, promotion of farm level and community level processing of diversified products and byproducts obtained from coconut palm are highly imperative. Technological research has been successful in evolving appropriate processing technologies for the profitable utilization of products and by-products of the coconut palm including tendernut, coconut kernel, coconut water, coconut wood, shell and leaves. 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.

Of late, virgin coconut oil is getting popular as a value added product in the domestic and export markets. Virgin coconut oil is the oil obtained from fresh, mature endosperm (kernel-meat) of the coconut by mechanical or natural means, with or without use of heat, no chemical refining, bleaching or de odorizing and maintains the natural aroma and nutrients. It is called "virgin" because the oil obtained is pure, raw and pristine. Virgin coconut oil is suitable for human consumption in its natural form. It is the purest form of coconut oil, crystal clear, contains natural vitamin E and with very low, free fatty acid content (0.1 %). It has a fresh coconut aroma ranging from mild to intense depending on extraction process.

The different processes involved in VCO production are Hot-processing method, Natural fermentation method, Centrifugation process and extraction from dried grating (EDG) method. The choice of the technology to be adopted depends to a great extent on the scale of operation, the degree of mechanization, the amount of investment available and the market demand. The modified hot process method for producing VCO also follows the same principle except for controlled heating to prevent the oil from turning yellow and maintain the moisture content less than 0.2 % to prolong its shelf life. Hot process comprises of two stages: extraction/ preparation of coconut milk and cooking the milk to get VCO. In fermentation method, the VCO can be produced in a home-scale operation using ordinary kitchen utensils after extracting the coconut milk. The oil produced in this method is water-clear in colour. The VCO produced could turn sour if the fermentation period is prolonged and the fermentation process conditions are not controlled properly. Fermentation method comprises of two stages: extraction/ preparation of coconut milk and fermentation of the milk for VCO production. In centrifugation method, the coconut milk is subjected to mechanical phase separation process. Coconut milk and hot water is fed in a three-way centrifuge equipment where the oil

separates out from the top and the water and sludge comes out through separate outlets. It produces the best quality oil with sweet coconut aroma and the oil produced in this method is water clear in colour.

Quality standards for VCO as fixed by Asian Pacific Coconut Community (APCC) are as follows:	
Chemical parameters	APCC quality standards for VCO
Colour (Lovibond)	Water clean
Refractive index at 40°C	1.4480-1.4492
Saponification value	250-260
Iodine value	4.1-11.0
Specific gravity at 30°C	0.915-0.920
Moisture (%)	0.1-0.5

Another strategic area which has raised lot of expectation is the potential for production and marketing of neera. Various value added products like coconut palm sugar, palm jaggery, coconut honey and coconut syrup can also be made from neera. Technologies are now available for preserving and packing coconut inflorescence sap as 'neera 'or sweet toddy as non-alcoholic health drink. The Government of Kerala has amended the abkari act and coconut producer federations are issued license to produce, process and market neera. Many such federations have started producing and marketing neera. Issues concerned with neera production at policy level include ceiling for the number of coconut palms to be tapped/ day, the selling controls on the product, the registration formalities etc. In the production front, scarcity of skilled tappers and lack of adequate infrastructure for processing are the major problems. Marketing of neera also poses challenges as consumer perception and buyer segment studies are completely lacking and profit analysis are based only on projections without any structured marketing studies. Further to compete with other similar product, it has to be appropriately positioned for its nutritional edge. As demanded by the Coconut Producer Federations efforts are required for the assessment and refinement of neera production technologies. Since it is an evolving product, lack of product uniformity may hamper the market penetration. However, the unexplored markets and preparedness to meet the demand are the opportunities.

Encouraging more entrepreneurs in coconut sector by establishing 'Coconut Parks' by state government for organized processing for value addition will help coconut farmers to de-link the over dependence on coconut oil in determining coconut price.

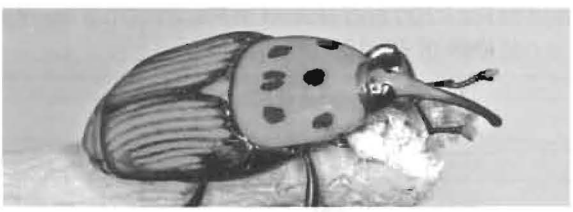
ICAR-CPCRI supports entrepreneurs who are interested in coconut based agribusiness ventures. Hands on training on potential technologies with nominal technology transfer fee and MoA between CPCRI and entrepreneurs is done through agribusiness incubation centre of CPCRI.

V. Farmers' experience huge crop loss in coconut due to insect pests like, rhinoceros beetle and red palm weevil. Recently, spiralling white fly has also been observed in various localities of coconut growing areas. What are the scientific crop protection measures against these pests?

Integrated pest management practices have been standardized by ICAR- CPCRI. Judicious use of various management practices namely, cultural,

Rhinoceros beetle	
Symptoms	**Management**
• Adult beetles bore into the spindle leaf causing diamond shaped cuts (V-shaped) upon unfurling as well as exposing chewed up fibres from feeding site. • Beetles feed on the unopened inflorescence leading to necrosis and drying of spathe. • Beetles bore into the collar region of the young seedlings.	• Hooking out the beetle • Filling up top most leaf axils with 250 g neem cake along with equal volume of sand. • Placement of two naphthalene balls on top-most two leaf axils Placement of two perforated sachets containing chlorantraniliprole (0. 4% ai) (3 g) or fipronil (80% ai) (3 g) • Incorporation of weed, Clerodendron infortunatum on the manure pits to induce larval-pupal abnormalities in feeding grubs. • Application of green muscardine fungus, Metarhizium anisopliae on the breeding pits @ 5 x 1011 spores / m3. • Release of 10-12 virosed (Oryctes rhinoceros nudivirus) beetles for pest reduction. • Use of PVC pheromone traps 'Oryctalure [ethyl 4 methy octonoate]' and field delivery using nanomatrix @1 trap / ha

Rugose Spiralling Whitefly	
Symptoms	**Management**
• Sucking of coconut sap by selective feeding on the under surfaces of the leaflets. • Extensive feeding leads to the excretion of honey dew which subsequently gets deposited on the upper surface of the leaves which later turn black colour.	• Application of 1% starch solution on leaflets to flake out the sooty moulds. • Installation of yellow sticky traps on the palm trunk as well as in interspaces to trap adult whiteflies. • Encourage build up of parasitoids (Encarsia sp.) and re-introduce parasitized pupae to emerging zones of whitefly outbreak. • In severe case, spray neem oil 0.5% and no insecticide is recommended.



Red palm weevil	
Symptoms	**Management**
• Choking of spindle leaves with improper emergence and sometimes wilting. • Yellowing of middle whorls (1-2 fronds) at the site of attack • Leaf splitting, presence of feeding bore holes in fronds, trunk with exudation of viscous brown fluid. Toppling down of crown in advanced stage of infestation.	• Systematic diagnosis and vigilant scouting for early diagnosis. • Avoiding physical injury to palms • Cutting fronds leaving at least 1 m from trunk, evading knife injury on crown region • Prophylactic leaf axil filling with oil cakes (250 g) admixed with equal volume of river sand/ naphthalene balls (12 g)/ polythene-sachet containing 3 g chlorantraniliprole (0.4 %) or 3 g fipronil • Application of 0.02% imidacloprid 17.8 SL (@1.12 ml per litre of water) • Growing of intercrops such as fruit trees and spices.

biological, mechanical and chemical methods are emphasized for managing these pests as described below.

Area wide community extension approach for managing coconut insect pests: ICAR - CPCRI took the initiative to evolve area wide community extension approach (AWCA) for management of coconut pests which was scaled up in several districts subsequently. The model community extension approach underscores the role of linkages with peoples' representatives, farmer organizations, farmer leaders, co-operative societies of farmers and co-ordination with various extension departments and research institutions.

The critical component of the extension approach is the decentralized option for technology facilitation viz. capacity building of farmer groups as master trainers and farm level producers of different critical inputs and targeting the 'potential and critical adopters' against major insect pests of coconut. Through this approach, more than 90 per cent of the potential adopters can be reached within short period and pest infestation can be reduced considerably.

Conclusion

Coconut is an important plantation crop which supports millions of farmers in India. Farmers are facing lot of field problems which are to be addressed by research and developmental agencies. Based on the experiences gained during the interactive video conferencing programme, it is felt that research-farmer-extension interface is the need of the hour to understand the field problems and also to create awareness on modern scientific technologies among farmers. Hence, this type of efforts should be continued for strengthening transfer of technology programmes for improving productivity and profitability from coconut farming. ■