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DSP Farm Mandya -
a vital source of coconut seedlings

Cocoa as a potential intercrop in coconut

FPOs
as agricultural technology promoters

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

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

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

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

'Kera Probio' also proved to support vigorous

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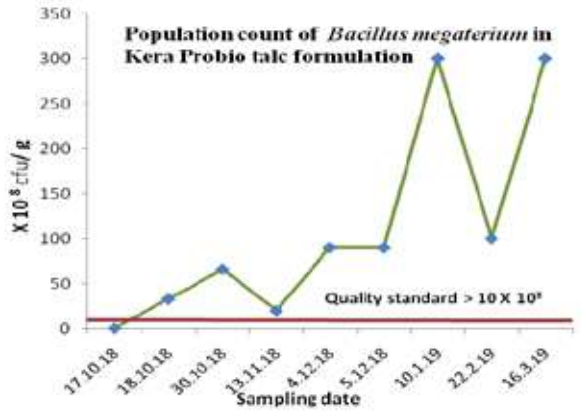
growth and yield of tomato, brinjal, chillies and other vegetables which are popular intercrops in coconut gardens. For coconut seedlings, the recommended dosage is 25g 'Kera Probio' mixed with 3-5kg of vermicompost or cow dung powder per seedling at the time of planting. Alternatively, dip coconut seedlings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

Technology access and ownership through FPOs

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

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



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

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

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

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

Keraprobio training in Microbiology lab, ICAR CPCRI, Kasaragod

Amplifying positive impact of research

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

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

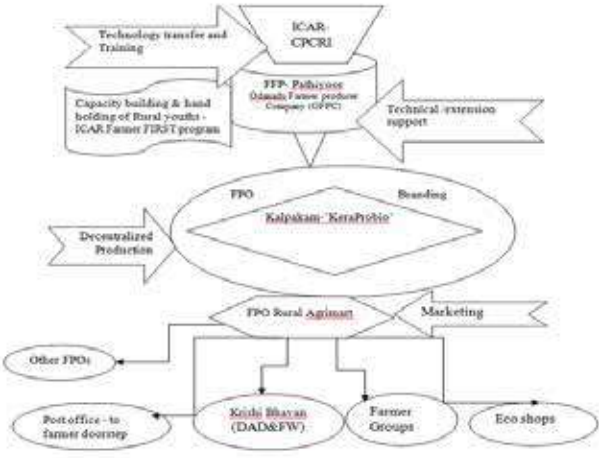


Fig 2. Diagramatic representation of the technology dissemination and social process with Farmer Producer Organization (FPO)

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

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

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