



# **Tropical tuber crops based cropping systems in coconut gardens for enhancing productivity and farm income**

## **A case of farmer participatory research cum demonstration**

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### **Introduction**

Coconut or 'Kalpavriksha', the tree of life with lot of virtues, is an important plantation crop that assumes the status of a high value commercial crop in India. Though, Kerala occupies the largest area (54%) under coconut, majority of the coconut holdings are small, which neither provides gainful employment opportunities to the family throughout the year nor generates sufficient income to meet the family requirement. The coconut farmers are also exposed to economic risks and uncertainties due to high degree of price fluctuations. The domestic price of coconut in India has also been showing a declining trend. The phyllotaxy and the unique plant architecture of the coconut tree offer ample scope for utilizing the greater portion (75%) of the unutilized area between the trees for intercropping.

Tropical tuber crops such as cassava, elephant foot yam and greater yam are ethnic starchy vegetables with good production potential, cooking quality and taste besides medicinal and nutritive values. Hence these are important as traditional food in the diets of the people of Kerala. It is estimated that tuber crops provide about 6% of the dietary energy, apart from being good sources of  $\beta$  carotene, antioxidants,

dietary fibre and minerals. They have higher biological efficiency, can tolerate drought and shade, withstand flooding and salinity to some extent and are adapted to marginal environments, low input situations and adverse soil and climatic conditions. These crops are less water and input demanding and relatively free from pests and diseases. Hence these crops are known as 'climate resilient' or 'future crops'. They also have immense industrial uses, in the production of starch, sago, alcohol, liquid glucose, vitamin C and as raw material for poultry and animal feed besides medicinal properties.

### **Scope and importance of coconut + tuber crops systems**

Cultivation of tropical tuber crops in the interspaces of coconut palms will enhance farmers' income and enable employment opportunities and the compatibility / flexibility of tuber crops in coconut gardens have been documented by ICAR-CTCRI. In particular, the food production can be substantially enhanced by integrating tuberous vegetables in the existing perennial tree-based cropping systems, since tuber crops are adapted to the same ecological conditions as plantation crops.



Besides, tuber crops also thrive well under partially shaded conditions unlike most other conventional vegetables like tomato, brinjal, okra etc., and cereals and perform well in a wide range of soil and climatic conditions. In such a system, the main crop provides the cash income, tuberous intercrops serve as high energy secondary staple to the farm family and feed for farm animals, behave as insurance crop against risk and natural calamities, enhance the resource use efficiency, ensure food security, augment net income and enhance employment opportunities.

The problems in coconut like no gainful employment, low income, pests and diseases, nutrient disorders, price fluctuations etc. need to be addressed for the development of coconut garden and sustainable livelihood of the coconut growers. The problems can be addressed very well and taken care of by the intervention of sustainable nutrient management technologies in tuber crops, a group of feasible under-storey crops in coconut gardens. Intercropping tuber crops in coconut gardens and adoption of sustainable soil health practices in tuber crops would enable higher yield (10-25%), higher

profit (20-30%) and gainful employment (220-250 man days ha<sup>-1</sup>) due to their higher biological efficiency and higher and stable price in the market (Rs. 40-50 per kg of tubers). With this background, thirty farmer participatory demonstrations have been planned in three districts of Kerala viz., Thiruvananthapuram, Kollam and Pathanamthitta with the objective of building resilience and generating higher productivity and profitability in coconut gardens through frontier nutrient management technologies in tuber crops.

### **Technologies for nutrient management in tuber crops**

ICAR-CTCRI has developed sustainable nutrient management technologies such as customized fertilizers suitable to various agro-ecological units (AEUs) based on site specific nutrient management (SSNM) and organic farming technologies in major as well as minor tuber crops. These technologies are adopted to increase the system productivity and profitability as well as ensure food-cum-nutritional security and sustainable livelihoods in the coconut-based homesteads of southern India.

Customized fertilizers based on SSNM: Technologies for SSNM have been developed in cassava, elephant foot yam and yams based on intensive research at ICAR-CTCRI for the last 15 years. This has resulted in the development of customized fertilizers for cassava and elephant foot yam, which enhanced the yield by 24% over farmers' fertilizer practice, besides maintaining soil quality. Customized fertilizers consisting of macro and micronutrients based on soil test values are used for managing the nutrient requirements in tuber crops to attain specific yield goals.

### **Organic farming package**

About 15 years of research on organic farming of tropical tuber crops at ICAR-CTCRI indicated that organic farming resulted in 10-20% higher yield, 20-40% profit, besides improvement in tuber quality and soil health. Organic production technologies have been developed in cassava, elephant foot yam, yams, taro, Chinese potato and arrowroot. Organic farming technology consisting of organically produced planting materials, organic manures, green manuring, bio-fertilizers, bio-control agents, biopesticides etc. are used for managing the nutrient requirements of tuber crops.

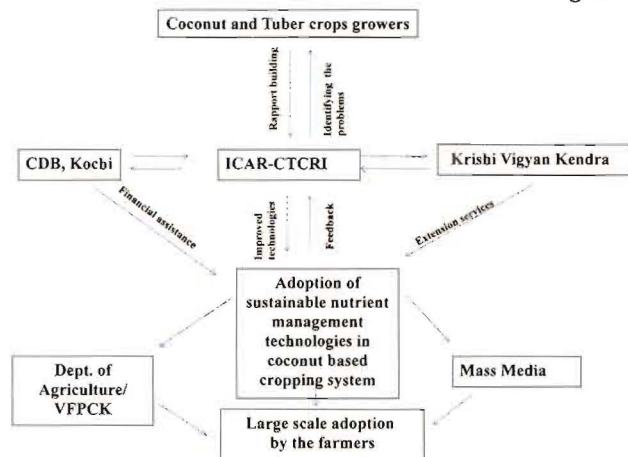
### **Partners in Farmers' Participatory Research**

Farmers' participatory research involves the

following partners in achieving the stable, sustainable and productive technology transfer for enhancing the productivity and farm income. The conceptual framework of the project is given in Fig 1.



Fig. 1



- Coconut and tuber crops growers
- Coconut Development Board, Kochi
- ICAR-Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram
- Department of Agriculture, Govt. of Kerala
- Krishi Vigyan Kendra
- Vegetable and Fruit Promotion Council, Kerala (VFPCK)
- Media- Press, Journals, Video

Farmers who had interest in taking up scientific interventions were selected based on the principles of participatory research and also based on the scoring procedure developed by the scientists of ICAR-CTCRI in consultation with the officials of Coconut Development Board, Krishi Bhavans and

Krishi Vigyan Kendras. Farmers who had coconut gardens with 50 cents each were selected for demonstrating technologies viz., customized fertilizers (SSNM) and organic farming (OF) in cassava, greater yam and elephant foot yam. Data on socio-economic background, available resources, farming details, farming practices, knowledge on coconut and tuber crops farming, constraints in farming etc. were collected in detail with the active participation of the farmers. Soil samples were collected prior to the start of the demonstrations and were analyzed for chemical properties. Demonstrations on SSNM and organic farming (Table 1) were carried out as per approved technical programme and already standardized technologies. Funds for establishing 30 demonstration plots in three districts were sponsored by Coconut Development Board, Kochi.

### Implementation of the farmer participatory demonstration

Farmer participatory demonstrations were established with the active participation of the farmers under the guidance and supervision of scientists and staff members of ICAR-CTCRI. Planting materials of improved varieties of tuber crops, critical inputs viz., customized fertilizers and organic inputs were supplied to the farmers. A total of thirty demonstrations were established in Thiruvananthapuram, Kollam and Pathanamthitta districts in Kerala for proving the technical feasibility and economic viability of the nutrient management technologies in coconut + tuber crops intercropping system.

The ICAR-CTCRI, Thiruvananthapuram, had also initiated a collaborative programme with Jail Department, Government of Kerala and Coconut Development Board (CDB), Government of India and established a 'Tuber Crops Museum' at Open Jail and Correctional Home located at Nettukaltheri, Thiruvananthapuram, Kerala. The programme started during March 2018 by providing planting materials, technical support and established an organic yam plot in coconut garden. The harvest of the organic yam crop as well as establishment of a Tuber Crops Museum was inaugurated on 7<sup>th</sup> March 2019 by Mrs. R. Sreelekha I.P.S., Director General of Prisons, Kerala (Fig. 3). Dr. Archana Mukherjee, Director, ICAR-CTCRI graced the occasion and delivered the keynote speech. The ICAR-CTCRI has provided organic inputs as well as quality planting materials of 23 different varieties of tropical tuber crops for the establishment of the Tuber Crops Museum. This includes improved

**Table 1. Farmer participatory demonstrations on nutrient management technologies in tuber crops based cropping system in coconut**

District and panchayats	Month and year of start	Intercrop	Technology	No. of demonstrations
Thiruvananthapuram (Chenkal & Ottasekharamangalam panchayats, Neyyattinkara municipality and Thiruvananthapuram corporation)	May -June 2018	Cassava	SSNM	3
			Organic farming	3
		Greater yam	SSNM	2
			Organic farming	2
Kollam (Chavara and Panmana panchayats)	May-June 2019	Elephant foot yam	SSNM	3
			Organic farming	3
		Greater yam	SSNM	2
			Organic farming	2
Pathanamthitta (Koipuram, Mallapally, Aranmula and Kottanad panchayats)	May-June 2020	Cassava	SSNM	3
			Organic farming	3
		Greater yam	SSNM	2
			Organic farming	2
<b>Total</b>				<b>30</b>

varieties of cassava, sweet potato, elephant foot yam and white yam.

### Expected Output

These demonstration plots will serve as model plots for farmers and other stakeholders. Productivity and farm income from coconut and tuber crops will be enhanced by the adoption of nutrient management technologies and cropping system models. Upscaling of demonstrations will pave way for achieving sustainability of coconut and tuber crops sector in Kerala.

### Follow up

All the thirty demonstrations in three districts are being monitored for collecting the details on yield and economics of coconut and tuber crops for assessing the system productivity and profitability. Field days during harvest of tuber crops will be organized involving farmers and other stakeholders to recognize the success of the technologies and also to promote improved technologies of tuber crops in coconut gardens. On-farm demonstrations on customized fertilizers and organic farming technologies in tuber crops will help in increasing the productivity and profitability of coconut as well as upliftment of tuber crop growers. These trials and demonstrations will serve as model plots for other farmers to adopt improved technologies



Fig. 3)

in coconut farming, which warrant the efforts from all stakeholders viz., ICAR-CTCRI, CDB, Kochi, Department of Agriculture, Krishi Vigyan Kendra, farmers, input agencies, marketing traders etc. Productivity and profitability of coconut gardens through soil health management in tropical tuber crops are being documented and will be published in the form of success stories, technical bulletins and research papers. The validated technologies will be given to KVKs, Department of Agriculture and other line departments for popularization and scaling up of the technologies in larger areas for doubling farmers' income on a sustainable basis.

### Acknowledgement

The authors are grateful to the Coconut Development Board, Kochi, Ministry of Agriculture and Farmers' Welfare, Govt. of India for sponsoring the project. ■