INNOVATIVE EXTENSION APPROACHES FOR PLANTATION CROPS

C. Thamban
D. Jaganathan
S. Kalavathi
P. Anithakumari
K. P. Chandran
S. Jayasekhar

Innovative Extension Approaches for Plantation Crops

Thamban, C.
Jaganathan, D.
Kalavathi, S.
Anithakumari, P.
Chandran, K. P.
Jayasekhar, S.

ICAR – Central Plantation Crops Research Institute
Kasaragod – 671 124, Kerala

Innovative Extension Approaches for Plantation Crops

Published by

ICAR-Central Plantation Crops Research Institute
Kasaragod 671 124, Kerala, India

Edited by

Thamban, C.
Jaganathan, D.
Kalavathi, S.
Anithakumari, P.
Chandran, K. P.
Jayasekhar, S.

September 2016

Layout and Cover design: Shri. C. H. Amarnath

Printed at: NGK Memorial Co-operative Press, Kasaragod

Preface

Historically, as in other developing countries, plantation sector in India has been promoted as a means of foreign exchange earner, and at present plantation crops are grown in 3.7 million hectares in the country. Sustenance of 30 million small growers is linked to these crops, while the sector contributes Rs. 250 billion to the Gross Domestic Product of the country. The Indian plantation sector has inherent strengths of varied agro climatic conditions, huge domestic demand, highest productivity, strong research and development, and extension systems.

In the present era of globalization and trade liberalization, growers in the plantation sector face various challenges including price crash/price instability. So far the sector has not effectively utilized the possible linkages among various research, development and extension agencies for increasing the production and marketing efficiencies. The small holder perspective in research needs to be emphasized in plantation crops, considering the structure of operational holdings in this sector. Technologies appropriate for small holdings need to be developed for faster and wider technology adoption in the crops.

Enhancing utilization of technologies for higher productivity and value addition through product diversification, stable market and congenial government policies are pre-requisites for achieving inclusive growth and sustainability of plantation economy. Extension approaches which have taken a paradigm shift through strategies like aggregation of farmers for group activities, farmer participatory decentralized initiatives for production and distribution of elite planting materials, innovative capacity building programmes to address the issue of lack of skilled labourers etc are sure to contribute for sustainable development of Indian plantation sector.

This book is a compendium of writings by social scientists on extension approaches for plantation crops, and the aim of this endeavor is to provide theoretical as well as empirical platform to evolve a sustainability oriented innovation system in plantation crops. We are confident that this book will help the scientists, policy makers, Subject Matter Specialists of KVKs and officers of development departments for updating their knowhow on extension approaches in agriculture in general and plantation crops in particular.

We are grateful to the scientists/officers of ICAR institutes, Kerala Agricultural University, Rubber Board, Coconut Development Board and SUBICSHA for narrating their innovative extension approaches/ experiences for preparing this book.

We thank all the scientists and technical staff of the institute for their valuable help for preparing this book.

Editors

Contents

Innovative extension approaches for plantation crops (2016) : 1-21
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Extension approaches for sustainable development of plantation crops

Thamban, C. and Jaganathan, D.

Introduction

Plantation crops play a vital role in the agrarian economy of our country, particularly in the states of Kerala, Karnataka, Tamil Nadu, Assam and West Bengal. They occupy nearly six million ha of area in India which is about five per cent of the net cropped area. Plantation crops also provide employment opportunities to large number of people, especially women. Among the plantation crops coconut, arecanut, black pepper, cashew, and cardamom are known as small holders' plantations whereas tea, coffee, and rubber are known as estate crops. India is the largest producer of coconut, arecanut, cashew, tea and pepper. Though plantation sector was a huge foreign exchange earner in the earlier times, of late, the role of the plantation sector in the Indian economy and the institutional arrangements for plantation development has undergone major changes in the present era of trade liberalization subsequent to formation of WTO and signing of various international/regional trade agreements.

During earlier times the state interventions were very pro-active to sustain the plantation economy and to protect the interests of farming community, while the current regime is characterized by selective state intervention and removal of tariff barriers. Hence, to remain competitive in this era of trade liberalization, growers need to effectively utilize technologies for enhancing productivity, reducing cost of cultivation and value addition through product diversification. Different agencies are involved in the development and dissemination

of technologies as part of the broader plantation innovation system. To be effective, the knowledge generation and technology transfer process has to take into account the unique characteristics of the crops and the resource endowments of the farming community in the plantation sector. Various aspects of technology transfer, field level utilisation of technologies and extension approaches in plantation sector are discussed hereunder.

Field level utilization of technologies

A substantial number of technologies for enhancing productivity and income from plantation crops have been evolved at research stations. These technologies mostly related to improved varieties, agronomic practices including nutrient management, irrigation and water management, cropping/farming systems, integrated pest and disease management and value addition through product diversification. However, studies revealed that adoption of these technologies by the farmers is 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. Field level utilisation of technologies like promising varieties, high production and pest and disease management strategies in pepper and cardamom is also low resulting in low productivity. In black pepper and cardamom the potential yield realized in the progressive farmers' gardens and research station are very high and well above the national average. Productivity level (kg/ha) being 2000, 2445 and 283 respectively in black pepper and 1625, 450 and 181 respectively in cardamom. Similarly a study on adoption of improved practices of cardamom by small farmers revealed that full adoption of practices is not followed by majority of the farmers. A study on the adoption of recommended technologies in oil palm revealed that most of the farmers were applying lower doses of major nutrients and majority of the farmers were not applying micronutrient fertilizers. And only one third of the oil palm growers were adopting the recommended practice of applying fertilizers in two split doses. Crop loss due to pest and

disease incidence is quite substantial in many of the plantation crops mainly due to the lack of adoption of timely IPM/IDM technologies. The level of value addition through product diversification is very low in plantation crops resulting in low income realised from farming.

The extent of technology adoption in large holdings/estates is higher when compared to the small and marginal holdings. A comparison between the best managed gardens and national average of productivity of plantation crops will 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 extension strategies suitable to the heterogeneous farming situations in different plantation crops.

Constraints to adoption of technologies

Plantation crops sector in India faces a number of challenges to attain economic and ecological sustainability. Price crash/price fluctuation in the market is the single most important problem experienced by growers in the plantation sector. 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 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 enough 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 plantation 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 plantation crops 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.

Deterioration of soil and water resources in the cultivated land is a major constraint adversely affecting sustainable production of plantation crops, ecological sustainability and income level of farmers. Extension initiatives for implementing interventions for empowering growers to adopt technologies on soil and water conservation and water harvesting for enhancing productivity of crops and thereby increasing income thus assumes much significance. World over there is a trend of increasing level of concern for food safety and environmental correctness among the consumers. The biggest handicaps that Indian spices face in the international market are the high cost of the product and high level of microbial contaminants including mycotoxin in the finished product. Hence, to remain competitive in the present day context farmers are to be oriented towards the need for cost effective hygienic production practices. Extension system has to take care of these concerns by evolving and implementing appropriate strategies.

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. However, in crops like tea where women work force dominates the labour sphere, both discrimination and deprivation occurs at various levels which has resulted in marginalization of the woman plantation labourers. 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 also.

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 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 plantation crops needs to be fully utilised. Decentralised participatory approaches for planning and implementing development/extension initiatives for the development of plantation crops sector are to be promoted to address location specific problems in plantation crops.

Knowledge generation and technology transfer in plantation sector innovation system

Organizations involved in the knowledge generation and technology

transfer as part of the plantation sector innovation system play an important role in the sustainable development of plantation crops. ICAR institutes, SAUs and research institutions under commodity boards are the major actors in the research domain of plantation sector innovation system in India. There are various organizations involved in providing extension services as part of the intermediary domain of the innovation system in plantation sector. The research organizations under ICAR such as ICAR-Central Plantation Crops Research Institute (ICAR-CPCRI), ICAR-Indian Institute of Spices Research (ICAR-IISR), ICAR-Indian Institute of Oil Palm Research (ICAR-IIOPR) and ICAR-Directorate of Cashew Research (ICAR-DCR) conduct front-line TOT programmes in their mandate crops. State Agri/ Horticultural Universities also organise frontline extension activities for the promotion of plantation crops. Krishi Vigyan Kendras (KVKs) implement interventions for technology assessment and frontline extension activities related to the plantation crops which are important in the prevailing cropping systems of the respective districts they are located.

Mainstream extension system with Ministry of Agriculture and Farmers' Welfare at the centre and State Agriculture/Horticulture Departments at state level implement technology transfer and development schemes for the improvement of plantation sector. Extension programmes relevant to plantation crops are also implemented through the Agricultural Technology Management Agency (ATMA) initiative supported by Central and State governments. Various commodity boards are also functioning for the development of specified plantation crops. They include Directorate of Cashewnut and Cocoa Development, Spices Board, Coffee Board, Tea Board, Rubber Board and Coconut Development Board. Farmer organisations supported by governmental agencies also involve in the implementation of extension and development interventions in plantation crops sector eg. Coconut Producer Societies, Rubber producer Societies etc. Local Self Governments (LSGs) also implement development interventions

in some of the plantation crops like coconut through decentralised planning process. The private sector farmer organisation, UPASI (The United Planters' Association of Southern India) which is an apex body of planters of tea, coffee, rubber, black pepper and cardamom in the Southern States of India undertake activities related to economic research, market intelligence, industrial relations, liaison, public relations, scientific research and publication. Various Farmer Producer Organisations (FPOs) and NGOs are also involved in organizing technology transfer activities in plantation crops.

The scheme of uptake pathways for coconut research output is depicted in Fig. 1. below:

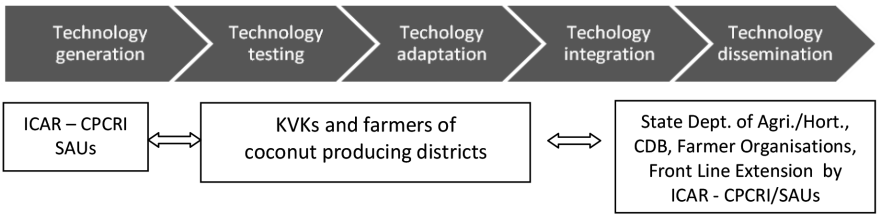


Fig. 1. Scheme of uptake pathways for coconut research output

Though a plethora of agencies and initiatives are involved in implementing interventions to improve the livelihoods of small and marginal farmers in plantation crops sector, the extent of field level utilization of technologies for realizing higher productivity and income has been far from satisfactory. In the present era of globalization and liberalized trade, innovations, especially in the research domain and in the delivery of extension services under the intermediary domain, apart from a congenial policy environment and support structures including marketing infrastructure would be the key for enhancing the efficiency in plantation sector.

Extension approaches for plantation crops

The low level of utilisation of technologies in farmers' fields calls for the formulation and implementation of innovative extension strategies

for sustainable development of plantation crops. Extension approaches for enhancing technology utilization in plantation crops, to be effective, need to take into account various factors such as long gestation period and perennial nature of the crops, predominance of small and marginal holdings, declining natural resources, lack of availability of skilled labour and high wage rate, price crash and price fluctuation in the market, enabling policy environment for sustainable development of the sector etc. Extent and quality of participation of growers in formulating and implementing extension interventions is also an important factor influencing the success of extension interventions. Participatory extension approaches have been pilot tested through action research by ICAR-CPCRI for enhancing technology utilisation for higher productivity and income from coconut farming (Thamban *et al*., 2016). Commodity boards like Rubber Board and Coconut Development Board also have been implementing innovative extension approaches for enhancing adoption of technologies by farmers. Some of the alternate extension initiatives in plantation crops, mostly in coconut, implemented for improving technology utilisation by farmers are summarised in Table 1 below:

Table 1. Alternative extension approaches in plantation sector

Sl. No.	Project	Extension approach	Impact	Reference
1.	ICAR-CPCRI initiative on 'Interactive video-conferencing' as part of cyber extension	Research-Extension-Farmer Interface facilitated through effective use of information and communication technology (ICT). Experiences of CPCRI have clearly shown that interactive videoconferencing as an ICT tool can be effectively used for linking research, extension and farming community. Farmers have perceived high utility for the interface programmes facilitated through videoconferencing since they were able to have one to one interaction with scientists and could get technical guidance on various field problems experienced in farming.	There is scope to further enhance the effectiveness of interface programmes facilitated through conducting follow up programmes.	Thamban et. al., 2013
2.	Project sponsored by IPGRI and implement-	Facilitating coconut farmers and rural women to form	The net income from the coconut farming could be	Thamban et al., 2011, 2012

	ed by ICAR-CPCRI for developing sustainable coconut based income generating technologies in poor rural communities.	Community Based Organisations (CBO) for sustainable income enhancement through efficient management of resources to reduce cost of cultivation and to increase productivity through integration of technologies in small farm holdings.	increased through the technology interventions and micro-enterprises introduced in the communities. Women Self Help Groups formed under the project started enterprises for commercial production and marketing of coconut high-value products.	
3.	IFAD funded project implemented by ICAR-CPCRI on 'Overcoming Poverty in Coconut-Growing Communities: Coconut Genetic Resources for Sustainable Livelihoods in India'	Approach of implementing the project involved conservation of coconut diversity along with diversification of crops and allied income generation activities as viable strategies to sustain the livelihoods of small and marginal coconut farmers. Community Based Organizations (CBOs) served as ideal vehicle for carrying out the project interventions in the project sites.	The indicators of socio-economic and food security/nutrition status revealed significant impact due to the project interventions.	Thamban, 2010

4.	Project implemented by ICAR-CPCRI on Cluster approach among coconut farming community for improving productivity and income from small and marginal coconut based homesteads.	Promoting group approach among coconut farming community for improving productivity and income from small and marginal coconut based homesteads' in the root (wilt) affected coconut area. The farm family members of 25 hectare area clustered together for deciding the farm strategies; both individual and group ventures for improving productivity and income.	Knowledge and adoption of the technologies significantly improved through extension interventions and training programmes. The average yield of coconut was doubled after technology package implementation for three years.	Thamban, 2010
5.	ICAR sponsored National Agricultural Innovation Project (NAIP) sub-project on 'Value chain in coconut' implemented by ICAR-CPCRI	Organizing small and marginal coconut farmers at grass root level into clusters (each cluster covering 25 ha of coconut holdings on a contiguous basis) with the aim of integrating interventions related to production and processing technologies for enhancing productivity and income from	The experiences of CPCRI in facilitating Community Based Organisations of small and marginal coconut growers under the NAIP evidently reflects that better technology integration is possible through group approach for enhancing productivity and income. In the project area where group ap-	Thamban et al., 2016

		coconut farming. 10 clusters were formed and interventions related to technologies viz., basin management with green manure legumes, intercropping and integrated disease management were implemented in the selected coconut holdings. Training programmes and demonstrations on various aspects of coconut farming were conducted.	proach was implemented, the average yield of coconut was substantially increased after technology package implementation.	
6.	ICAR sponsored National Agricultural Technology Project implemented by ICAR-CPCRI on Participatory technology transfer approach (PTT) for areas affected by coconut root (wilt) disease	First line technology assessment and transfer with the active participation of farm families of manageable contiguous area in coconut root (wilt) disease affected tracts. Multidisciplinary team of scientists, extension officials, farmer representatives, local village representatives, women, youths, groups etc form	The awareness, knowledge, adoption and attitude of farmers towards the technology package for the integrated root (wilt) disease management technologies) were improved by 40-85 per cent over the pre implementation level.	Thamban et al., 2016

		the stakeholders. Participatory rural appraisal tools were employed for pre implementation, appraisal at 6 monthly interval and also post implementation of the project.		
7.	ICAR-CPCRI project sponsored by Asia Pacific Coconut Community on Farmer Field Schools for IPM of coconut organized	The concept of farmer field schools (FFS) was implemented for the IPM of rhinoceros beetle in coconut organized in 15 locations.	Level of knowledge and awareness of farmers were improved by 100 per cent over pre FFS level.	Thamban et al., 2016
8.	ICAR sponsored National Agricultural Technology Project (NATP) project on Technology Assessment and Refinement through Institution-Village Linkage Programme (IVLP)	Farmer participatory technology assessment and refinement approach, the implementation of which begins with the selection of a suitable village, followed by a detailed agro-ecosystem analysis, diagnosing the problems of each production system and prioritising these problems; identification of technological	Implementation of the project revealed the effectiveness of participatory approach in the performance assessment of various technologies related to intercropping, nutrient management and crop protection in coconut.	Thamban et al., 2004

		interventions based on problem-cause relationship; the development of action plans and their implementation; and detailed socio-economic evaluation including farmers' reactions and perceptions about the interventions. This is carried out using various PRA tools and techniques.		
9.	Project sponsored by Ministry of Water Resources implemented by ICAR-CPCRI on Farmer Participatory Action Research Programme (FPARP) on 'Soil and water conservation and water harvesting in the west coast region of Kerala'	Farmer participatory approach to enhance the adoption of soil and moisture conservation techniques and low cost water harvesting technologies in coconut based farming systems was employed under the project implemented in 20 selected villages. Extension methodology was evolved for integrating six technologies for soil and water conservation and five technologies for low cost water	Due to the adoption of soil and water conservation and water harvesting in coconut gardens, productivity of coconut increased by 19 per cent ie from 54 nuts per palm to 64 nuts per palm per year. The impact of interventions under the FPARP project motivated Local Self Governments and development agencies to replicate the technologies in the region through decentralized planning	Thamban et al., 2014

		harvesting in farmers' coconut gardens.	and other NRM initiatives.	
10.	Rubber Board scheme on Rubber Producer Societies (RPSs)	Rubber Producer Societies (RPSs) are small growers voluntary institutions, which are socially-driven non-profit entities, registered under charitable societies act and facilitated by Rubber Board. The concept was introduced in 1986 and the RPSs undertake the task of imparting technical and scientific know-how for the inclusive development of the area and in particular, for the economic and social welfare of the small growers of rubber.	RPS had a profound influence in ensuring adoption of scientific cultivation practices in rubber by the small growers. The major factors which prompted participation in RPS were access to technical information, need for group activity through RPS and direct financial benefits. The extension strategy proposed by Rubber Board is devolution of extension functions by involvement of the RPS in a phased manner. Studies showed that 33 % of the growers are members of the RPS and 27% of the growers reported that they receive technical information from the RPS. Studies also revealed the impact of efficient	Krishnakumar and Dhanakuma, 2000

			functioning of RPS on increasing production, improving the quality of life and disseminating information on issues related to rubber cultivation. In the well performing RPS, as perceived by the members, 70% of members attained high production, 56.7% improved their quality of life and more than 80% paid attention to issues related to rubber.	
11.	CDB scheme on facilitating Coconut Producer Societies/ Federations/Companies		A total of 9332 CPSs, 728 CPFs and 66 CPCs have been formed under CDB. Decentralised coconut nurseries for the production and distribution of quality coconut seedlings have been taken up by many CPFs. Similarly, about 200 CPFs secured licence for the production and marketing of neera in Kerala state out of which 95 CPFs have started	http://coconutboard.nic.in/cps.htm

		Facilitating group approach by providing support to Coconut Farmers Producer Organizations (FPOs) for the socio economic upliftment of the farmers through productivity improvement, cost reduction, collective marketing and processing and product diversification. The Coconut Farmers Producer Organizations have a three tier structure consisting of Coconut Producers Society (CPS), Coconut Producers Federation (CPF) and Coconut Producers Company (CPC). Coconut Producer Societies (CPS) are formed by associating 40-100 coconut growers in a contiguous area with a consolidated minimum of 4000-5000 palms. Legal status of CPSs is assured by registration under Charitable Societies Act.	the enterprises on the same. Formation of FPOs under the CDB scheme has created awareness among coconut growers about the importance of group approach for reducing cost of cultivation and also for enhancing income through better technology adoption giving thrust on value addition through product diversification.	

		Coconut Producers Federation (CPF) is formed by combining 8-10 CPS. A CPF would have around 1,00,000 palms under it. CPF is also registered as a charitable society and further registered with CDB. 8-10 CPFs would join together to form a CPC.		
12.	CDB scheme on Friends of Coconut Trees (FoCT)	Empowerment of rural youth through skill training to support coconut growers for coconut climbing and other crop management practices including harvesting and plant protection. CDB implemented the FoCT initiative to tackle the problem of acute shortage of trained coconut palm climbers for harvesting and plant protection activities which is a major constraint experienced by coconut growers	Initially it was aimed to train about 5000 underemployed youth in developing special skills and confidence in coconut palm climbing and plant protection activities for the benefit of the coconut community as a whole in Kerala state. However, the project was subsequently spread to other coconut growing regions and so far about 57000 youths have been trained under the FoCT programme in six phases during the period from 2011-12 to 2016-17 spread over 13 states.	Thamban et al., 2012

It can be seen from the Table that the innovative extension approaches, especially those implemented in coconut and rubber, have been mostly focused on facilitating farmer participatory group approaches among the small and marginal growers so as to overcome the inherent limitations to technology adoption owing to the fragmented holdings. The group approaches for enhancing the adoption of improved varieties, multiple cropping and integrated farming are very relevant in the present day context of growers in plantation crops sector facing difficulties due to price crash and price fluctuations in the market. The extension approach to facilitate FPOs for the production and marketing of value added products also is important for enhancing income and improving livelihoods of small holders in the sector. Depletion of natural resources in the orchards has been a major constraint to the sustainable production of plantation crops and the participatory approaches for formulating and implementing location specific interventions for soil and water conservation, water harvesting and conservation of agro-bio diversity assume much significance. Innovative extension initiative like the 'Friends of Coconut Trees' (FoCT) is noteworthy since it is addressing the problem due to the shortage of skilled labour which is a major constraint experienced by the farming community in plantation sector.

Conclusion

Innovative extension approaches play a significant role to enable farmers in plantation crops sector to effectively utilize technologies to remain competitive in the present era of trade liberalization. The impact of extension approaches clearly indicates their importance and relevance for sustainable development of the sector in the changing socio-economic scenario. However, concerted efforts by research, development and extension agencies coupled with active involvement of farming community and other stakeholders are required to scale up these approaches for effectively contributing to the sustainable development of plantation sector.

References

Krishnakumar A.K. and Dhanakumar V.G. 2000. An Assessment of Rubber Producers' Societies, (Self Help Groups of Small Growers) in Rubber Plantation Sector in India. "Plantation tree crops in the new millennium". Proceedings Indian Planters' Conference, 17-20 May 2000, pp. 491-502

Thamban, C. 2010. Extension approaches to enhance technology utilization and income generation in coconut farming. In. Proceedings of International Conference on Improving Productivity and Profitability in Coconut Farming (Eds. George V. Thomas V Krishna Kumar and B. Augustine Jerard), October 25-28, 2010, CPCRI Kasaragod. 443-456 pp.

Thamban, C., Muralidharan, K, Ravikumar, N. and Amarnath, C. H. 2013. Videoconferencing for organising research-extension-farmer interface programmes. Indian Coconut Journal LVI (7): 31-33

Thamban C., Subramanian, P. and Muralidharan, K. 2011. Nalikera moolyasringala-Keramekhala kooduthal karyakshamavum matsrakshamavumakkan noothana padhathi (Malayalam). Indian Nalikera Journal 2 (5): 3-9

Thamban, C., Jayasekhar, S., Chandran, K. P. and Muralidharan, K. 2012. Women empowerment through coconut based microenterprises. Indian Coconut Journal 54 (11): 15-17

Thamban, C., P. Subramanian, S. Jayasekhar, D. Jaganathan and K. Muralidharan.2016. Group approach for enhancing profitability of small holders through technology integration - Reflections from coconut farming. Journal of Plantation Crops. 44(3) : 158-164

Thamban, C., Arulraj, S. and Sairam, C.V. 2004. Farmer participatory technology assessment and refinement in coconut through Institution Village Linkage Programme – Experiences of CPCRI in India. Journal of Plantation Crops. 32 (sup.) : 459-464.

Thamban, C., Mathew, A.C., Subramanian, P., and Muralidharan, K. 2014. Soil and Water Conservation Measures for Sustainable Coconut Production – Impact of Interventions under Farmers Participatory Action Research Programme. Journal of Plantation Crops. 42 (1) : 94-100

Thamban, C., Leena, S. and K. Muralidharan. 2012. Friends of coconut trees for sustainable coconut development –Strategies and linkages. Indian Coconut Journal. LV (1): 16-19

Thamban, C., Kalavathy, S., Anithakumari, P. and Jaganathan, D. 2016. Reaching Coconut Farmers and other Stakeholders. In. CPCRI Centenary Souvenir, ICAR-CPCRI, Kasaragod, Kerala, pp 97-110

Innovative extension approaches for plantation crops (2016) : 22-45
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Plantation sector in India: Scenario, issues, challenges and strategies

Jayasekhar, S.

Introduction

Plantation crops are considered to be the major segment of the horticulture crops and the mainstay of agrarian economies in many states and union territories of India. They contribute a significant amount to the national exchequer and country's exports by way of excise and export earnings. They also provide direct and indirect employment to a large number of people in the country. In the case of coconut, about 12 million people are directly dependent on coconut farming and its allied activities. Over six million people are engaged in arecanut cultivation, processing and trade. Nearly 2.00 lakh workers, more than 90% of which are women, are directly employed in cashew processing factories which are concentrated mostly in Kerala. It is estimated that nearly two million people are involved, directly and indirectly in cashew cultivation, processing and marketing.

The major plantation crops in India include coconut, arecanut, oil palm, cashew, tea, coffee, rubber and cocoa. India is the largest producer and consumer of cashewnut and arecanut. Tea and coffee are the main and oldest industries in the country, which provide ample employment opportunities to the people and hold immense potential for export. Above all, plantation crops like coconut and arecanut provides adequate interspaces for intercropping of seasonal crops and thus ensures the food security to a great extent. Nevertheless, in India, plantation crops have been continuously facing the problem of lack of investment and depressed yields, and are in great need of modernization. Their total coverage is comparatively less and they are mostly confined to small

holdings. Plantation crops sector in India, in recent times characterised by selective state intervention and the removal of tariff barriers wherein, its survival depends on international competitiveness. During the important substitution period the role played by the plantation sector was very crucial in terms of foreign exchange earnings, but lately with a vibrant and dynamic service sector contributing a major chunk of export earnings, and a liberalized trade regime the importance of plantation sector has declined. Nevertheless, plantation sector in the country is dominated by millions of small and marginal farmers and mainly confined in the economically and ecologically vulnerable regions, plays a crucial role as far as the issue of sustainability is concerned. In the present context, the major challenge is to develop an equitable and sustainable plantation sector ensuring the inclusive growth and at the same time being internationally competitive.

Glimpses of historical evolution

Forceful means of colonialism and imperialism conditioned the local farmers in the tropics to grow cash crops like tea, coffee, cocoa, pepper and cardamom to export. Emergence of plantations in India indubitably was a part of the commercialization strategy adopted by the British planters. Geographical spread and development of plantations in the world was in tune with the expansion of colonialism and imperialism. Though tropical countries have been producing the entire world's plantations, its processing and marketing have been carried out by few firms located in temperate zones of Europe and America. Plantation development in India is no way different from the expansion and development of the cocoa in West African countries. In both the instances, the developmental roots can be very well traced to the imperialism and colonialism. In fact the development of cocoa in India was categorized as dependent development. It is a matter of fact that the western colonialists, who dominated over the Malabar Coast from time to time, conditioned the agriculture in India, and especially in Kerala to serve the interests of the metropolis. But unfortunately, though colonialism has disappeared from the national scenario of Indian polity, the economic strings attached to it still persist through the large number of multinational companies operating in the country.

They started operating in India in the post world war era and envisaged the agrarian economy of South India, particularly Kerala as a potential region for the production of raw materials required by them. Though plantation sector was a huge foreign exchange earner in the earlier times, of late, the role of the plantation sector in the Indian economy and the institutional arrangements for plantation development has undergone major changes. Where the earlier regime was that of protection and state intervention in almost all spheres of plantation development, the current regime is characterized by selective state intervention and removal of tariff barriers. So the survival of the sector is dependent on maintaining its competitiveness both in the domestic and international market. This pressure to maintain its competitiveness can be expected to have intensified in the regime of new trading environment resulting from formation of WTO and signing of various international trading agreements.

General scenario: A sector wise outlook

Rubber

The production of natural rubber in the country during 2016 was 5.62 lakh tonnes which marked an increase of 12.90% decline tonnes over the previous period (6.45 lakh tonnes). Among the major Natural Rubber producing countries, India stands at seventh position while Thailand stands at number one (Fig. 1), while in the case of consumption, India is in second position after China. Kerala accounts for 78.2 per cent of the area under rubber in the country. Adverse weather conditions, high wages, lack of skilled labourers, and grower's reluctance in harvesting in response to low NR prices adversely affected the production. The NR prices for the last five years are depicted in Table 1.

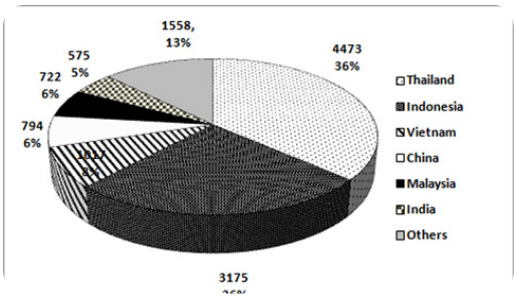


Fig. 1. Natural Rubber Production in the world ('000 tonnes) in 2016

Table 1. Rubber prices last five years

Year	Domestic Price (Rs/100kg)	World Price (Rs/100kg)
2011-12	20805	20915
2012-13	17146	16432
2013-14	16602	15525
2014-15	13257	11271
2015-16	11306	9636

Source: Economic Review 2016

Tea

Worldwide, the sector provides employment to millions of people. China is the leading tea producer in the world followed by India (Table 2). Tea production and export is a vital part of the economy for producing countries in terms of employment in rural areas. However, for countries such as Kenya and Sri Lanka which export most of the tea they produce, and which together control 40 per cent of world exports, tea trade is also important within the economy as a whole. Almost 56 per cent of all tea produced worldwide is consumed locally. And while world tea production doubled over the past three decades, demand is lagging behind, creating a situation of over supply.

Table 2. World tea production in million kgs (2016)

Country	Production	% share
China	2350	43
India	1234	23
Kenya	475	9
Sri Lanka	292	5
Vietnam	165	3
Indonesia	126	2
Others	821	15
Total	5463	100

Source: Tea Board 2016

In India, Assam is the major tea producer followed by West Bengal (Table 3). Wages for plantation workers, the majority of the workforce in this sector, are generally low in India.

Table 3. Area and production of Tea in India (2015-16)

State	**Area ('000 ha)**	**Production (million kgs)**
Assam	307.08	652.95
West Bengal	140.44	329.77
Other NE States	12.29	25.91
Tamil Nadu	65.62	161.46
Kerala	35.01	56.63
Karnataka	2.22	6.46
Total	566.66	1233.14

Source: Tea Board 2016

Coffee

Coffee is cultivated in about 80 countries across Asia, Central and South America and Africa. Approximately there are 25 to 30 million coffee farmers and nearly 70% of global coffee is grown in farms of less than 5 ha holdings. Apart from being constrained by their weak socio-economic conditions, small holders across the globe have found it most difficult to adjust to free market conditions especially in those countries where they were hitherto protected by pooled marketing systems, administered by marketing boards.

In India, Karnataka is the leading producer of coffee, and Kerala, Karnataka and Tamil Nadu together produce major share of the coffee produced in the country (Table 4) The livelihoods of small growers in India is characterized by fragile entitlements, low-waged family, low level of capitalization, depleted human and natural resources with livelihoods crisis. In a country like India, owing to peculiar agro-climatic conditions arising from a wide range in temperature and lack of even-distribution of rainfall throughout the year, there is a compulsion to

grow all coffees under shade so as to maintain the ideal microclimate. While this has distinct advantages, it also inhibits overall productivity, relative to coffee grown under open conditions.

Table 4. Production of coffee in major states of India (in MTs): 2016-17

State	Arabica	Robusta	Total
Karnataka	70,510	151235	221745
Kerala	2,140	61,125	63,265
Tamil Nadu	11,850	4,485	16,335
Andhra Pradesh	9,750	50	9,800
Orissa	650	0	650
North Eastern Region	100	105	205
Grand Total	95,000	217,000	312,000

Source: Coffee Board 2016

Cashew

Cashew, a native of Eastern Brazil was introduced to India by the Portuguese nearly five centuries ago. India was the first country to hit the world market with cashew kernels and it was India who pioneered cashew processing as an industry. India has the largest area under cashew in the world (Table 5) and it is grown in Kerala, Karnataka, Goa and Maharashtra along the west coast and Tamil Nadu, Andhra Pradesh, Orissa and West Bengal along the east coast. Cashew occupied an area of 1.04 million hectares in the country in 2016-17, with a production of 0.77 million tonnes (Table 6). The highest productivity is observed in Maharashtra with over 1.3 tonnes per ha. India is also one of the largest cashew consuming countries in the world. The requirement of raw nuts in the industry is more than one million tonnes for processing, but the availability from internal sources is half of the requirement. The industry's dependence on imported raw nuts has gone up substantially, with indigenous production failing to keep pace with the growing demand for the raw material.

Table 5. Area, production and productivity of cashew

Country	**Area ('000 ha)**	**Production ('000t)**	**Yield (kg/ha)**
Côte d'Ivoire	1399	531	380
India	1011	753	745
Brazil	627	108	172
Benin	621	202	325
Indonesia	530	131	247
Tanzania	434	130	300
Nigeria	381	894	2349
Guinea-Bissau	290	156	536
Viet Nam	288	245	850
Others	458	563	656
World Total	6037	3713	615

Source: FAO, 2016

There are huge differences in the way each state has organised, promoted and facilitated cashew cultivation and harvesting, with consequences for the degree to which cashew supports sustainable livelihoods. This has immediate implications, not just for those involved in the cultivation and harvesting of nuts, but also for those involved in the subsequent set of activities, namely, marketing the nuts, distribution, processing and so on. It is an established fact that both women and men are active at the local level and that cashew can make a particularly important contribution to livelihoods in areas which are poorly endowed in natural resources.

Table 6. Production statistics of cashew in India 2016-17

State	**Area ('000ha)**	**Production ('000t)**	**Yield (kg/ha)**
Kerala	90.86	83.98	962

Karnataka	127.86	85.15	672
Goa	58.18	32.66	561
Maharashtra	186.20	256.61	1378
Tamil Nadu	141.58	67.65	478
Andhra Pradesh	185.57	111.39	600
Orissa	183.32	93.89	513
West Bengal	11.36	12.96	1140
Others	55.95	35.04	579
Total	1040.88	779.33	753

Source: DCCD, Cochin

Coconut

Among the plantation crops, coconut palm is the major crop grown both under plantation and homestead management system. It provides livelihood security to several millions of people across the world. Although coconut is widely dispersed in most of the tropical regions, and grown in 93 countries in the world, out of 12 million hectares of global area under this crop, close to ten million hectares is contributed by only four countries, namely Indonesia, Philippines, India and Sri Lanka (Table 7) and they contribute 79.09% of the total area under coconut and its production in the world. and capacity of coconut in providing improved nutrition, employment and income generation are well known. India has produced 22167 million nuts in the year 2015-16 from an area of 2.08 million ha with a productivity of 10614 nuts per hectare (Table 8). Kerala is the major producer of coconut, contributing around 34 per cent of the total production in the country. It is predominantly cultivated in small and marginal holdings. Most of these holdings neither provide gainful employment opportunities for the family labour throughout the year nor generate sufficient income to meet the family requirement. Presently coconut growers are more exposed to economic risks and uncertainties owing to the high degree of price fluctuations. In this context it is needless to emphasize the importance of crop diversification in coconut gardens.

Table 7. Area and production of coconut in the world (2015)

Country	Area ('000ha)	% share	Production (million nuts)	% share	Productivity (nuts/ha)
Indonesia	3571	29.8	14804	20.5	4530
Philippines	3517	29.3	14735	20.4	4196
India	1975	16.5	20440	28.4	10119
Sri Lanka	440	3.7	3056	4.2	6623
Tanzania	128	1.1	554	0.8	1379
Brazil	250	2.1	2893	4.0	11923
Papua New Guinea	221	1.8	1483	2.1	6709
Thailand	202	1.7	809	1.1	4859
Others	1684	14.0	13321	18.5	5662
Total	11988	100.0	72095	100.0	5777

Source: APCC, 2016

Table 8. Coconut: National scenario

State	Area ('000 ha)	Production (mn. nuts)	Productivity (nuts/ha)
Andhra Pradesh	104	1427	13732
Karnataka	526	5129	9744
Kerala	771	7429	9641
Tamil Nadu	460	6171	13423
Other States	227	2011	7295
India	2088	22167	10614

Source: CDB, 2015

Arecanut and Cocoa

Arecanut is another important plantation crop in India which plays a prominent role in the religious, social and cultural functions and

economic life of people in India. The present production of arecanut in the world is about 1.1 million tonnes from an area of 0.90 million ha. India ranks first in both area and production of arecanut (Table 9).

Table 9. Country wise area, production and productivity of arecanut

Country	**Area ('000 ha)**	**% share**	**Production ('000 t)**	**% share**	**Yield (kg/ha)**
India	452	49.9	622.0	56.3	1376
Indonesia	137	15.1	47.0	4.3	343
China	44.5	4.9	121.4	11.0	2728
Bangladesh	165.0	18.2	102.0	9.2	618
Myanmar	55.3	6.1	118.9	10.8	2148
Thailand	21.7	2.4	36.7	3.3	1688
Sri Lanka	16.4	1.8	41.9	3.8	2556
Others	2.0	0.2	17.5	1.6	----
World	905.8	100.0	1103.9	100.0	1219

Source: FAOSTAT, 2016

In India, arecanut is cultivated in an area of 472 thousand ha with an annual production of 735 thousand tonnes. Karnataka, Kerala, Assam and West Bengal are the major producers (Table 10). Arecanut industry forms the economic backbone of nearly six million people in India and for many of them it is the sole means of livelihood.

Seven varieties with high yield potential and two hybrids of arecanut have been released for commercial cultivation in the country. Suitable agro-techniques for arecanut and economically feasible cropping systems were developed as an answer to the recurring problems faced by the arecanut farmers such as high investment, weather aberrations, price fluctuations and pest and disease problems. Efficient recycling of organic wastes from arecanut plantation through vermicomposting has been standardised to supplement the chemical fertilizers.

Table 10. State wise statistics of arecanut in India 2015-16

State	Area ('000 ha)	% share	Production ('000 t)	% share	Yield (kg/ha)
Karnataka	235.77	50	436.29	59	1850
Kerala	99.13	21	132.45	18	1336
Assam	77.62	16	74.78	10	963
West Bengal	11.52	2	22.66	3	1967
Meghalaya	16.87	4	26.20	4	1553
Others	31.45	7	43.48	6	---
India	472.36	100	735.86	100	1558

Source: DASD, 2016

In the case of cocoa, the crop is grown in 58 countries in around 10 million hectares with an estimated production of 4.0 million tonnes during 2015-16 (Table 11). Among the major countries, Côte d'Ivoire has the highest productivity of 660 kg/ha, while the world productivity is 504 kg/ha. The four West African countries viz., Côte d'Ivoire, Ghana, Cameroon and Nigeria contributed for 73.3% of worldwide cocoa production.

Table 11. Production of cocoa beans (thousand tonnes)

Region	Production
Africa	2911
Cameroon	211
Côte d'Ivoire	1581
Ghana	778
Nigeria	230
Others	111
America	657
Brazil	190
Ecuador	270
Other	197

Asia & Oceania	397
Indonesia	320
Papua New Guinea	36
Others	41
World total	3965

Source: ICCO QBCS, Vol. XLIII, No. 1, Cocoa year 2016/17

In India, cocoa is cultivated mainly in the states of Tamil Nadu, Andhra Pradesh, Kerala, and Karnataka. At present, demand for cocoa beans is higher than the domestic production, necessitating large scale imports to meet the national requirements. India produced 17,200 tonnes of cocoa from an area of 81,274 hectares (Table 12). Tamil Nadu has the highest area under cocoa (34.7%), followed by Andhra Pradesh (29.7%), and while in the case of cocoa production, Andhra Pradesh has the major share (40.7%) followed by Kerala (37.8%).

Table 12. Cocoa area, production and productivity in India 2015-16

State	**Area (ha)**	**% share**	**Production (m. t)**	**% share**	**Productivity (kg/ha)**
Kerala	15344	18.9	6500	37.8	725
Tamil Nadu	28209	34.7	1500	8.7	300
Karnataka	13565	16.7	2200	12.8	440
Andhra Pradesh	24156	29.7	7000	40.7	590
Total	81,274	100.0	17,200	100.0	550

Source: DCCD, 2016

The cocoa industry in the country had expanded to a considerable extent in recent years. At present more than 15 industrial entrepreneurs and firms existing in the field demanding nearly 30,000 tonnes of cocoa beans of which the present domestic availability is only about 40 percent. Considering the market growth in the chocolate segment is In India, which is about 20 percent per annum, cocoa has a great potential to develop in future years.

Major Issues to Contemplate

Historically, plantations have been organized as large estate with mono-crop and over time, small holders have emerged as dominant players. Given the economics of small holder production, mono-cropping is unfavorable to small holders. But, the institutional arrangements are not conducive for mixed crop cultivation which is more environmental friendly as compared to mono-cropping. Therefore, the majority of the plantation crops in the country fall into the mono-cropping pattern. Moreover, crops like cardamom have been subjected to the heavy usage of chemical fertilizers. These factors evidently point towards the inappropriate institutional innovation system evolved in the sector which takes a paradoxical stand against the economic and ecological sustainability. Issues like, sanitary and phytosanitary measures, implementation of emission reduction projects and Clean Development Mechanism (CDM) etc are globally being implemented and would have its own stake in the Indian scenario as well. Predominance of small plantation owners in India in contrast to the globally emerging ecological sophistication is another contemplating issue.

Among many challenges confronted by the Indian plantation sector, those related to prices could be treated as one of the most significant. In India, plantation sector, of late has become highly domestic market oriented with a share in exports of around one per cent during 2010-11 (Anoop Kumar, 2012). Apart from the erosion of external markets, the sector currently faces import threats from other low cost producing competitors, especially after the new free trade agreements like the India-ASEAN FTA (Nagoor, 2010; Veeramani and Saini, 2011). 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 (Brigit, 2004; UNCTAD, 2008). Though the role of plantation sector in the export basket of India declined over the years, the present role of plantation sector in India's national economy is more important than ever before. Today, plantation sector is a key sector in India's inclusive growth strategy which is being upheld from 11th five year plan

onwards. This is on account of its significant contribution towards the livelihood of millions of plantation workers – especially women labour and marginalized sections - small and marginal growers, balanced regional development and addressing environmental concerns and global warming (Joseph, 2010).

Livelihood and Employment for Small and Marginal Holders

Deceleration in agricultural growth in the recent decades had detrimentally affected the small and marginal holders in the country. In fact the intensity of this marginalization is very well reflected in the steadily declining operational holding size which has become (0.52 ha at present). Inclusive growth envisaged by the government can only achieve with a much faster growth realized in the agrarian sector. A glance to the history on evolution of plantation sector reveals that, the sectoral development was in tune with the infrastructural development of the regions where the plantations were established. There has been a large scale participation of small holders in plantation commodities. The flexibility and economies associated with family based production has also contributed to the emergence of small holder domination in the plantation sector (Hayami and Damodaran 2004). In India, plantations are concentrated in the backward states of Northeast and backward districts of states like Kerala, Karnataka and Tamil Nadu. Hence, a strategy towards achieving spatial balance in development could hardly afford to ignore the plantation sector that is the main stay of development in some of the least developed regions in the country. Therefore, any strategy towards balanced regional development in India can hardly afford to ignore plantation sector.

Most of the plantation crops in India are cultivated by small holder producers. For example 93 per cent of the total rubber production in the country is done by nearly 1.3 million of small farm holdings with an average holding size of 0.54 ha. Holdings less than 2 hectares constitute 81 per cent of the total number of holdings in coffee. The direct and indirect employment generation potential of the sector is well documented. The tea industry is India's second-largest employer

with over 3.5 million workers employed across the tea-growing estates. The average number of persons employed daily in coffee plantations is estimated to be 0.62 million during 2012-13. In the case of rubber plantations the average daily employment increased from 0.16 million in 1976 to 0.46 million in 2010-11. Similarly other plantation crops also provide productive employment to the significant number of workers. The indirect employment provided through the respective industries and its associated firms will be more than the direct employment as these crops require extensive post-harvest processing and value addition.

The labour market institution in the plantation sector certainly lacks the collective bargaining power. A large number of trade unions are functioning in the sector with lack of focus and thereby not claiming much stake in the wage determination process of the sector. Apart from this the women workers who contributes around 50 per cent of the work force are discriminated and do suffer from the sectoral decisions on wage, livelihood and work pattern. An analysis of last 20 years shows that the real wage rate (although nominal wage rates increased) fell in the case of plantation sector which indicates again the failure of collective bargaining power. A comparative analysis of three major sectors (mining, manufacturing, and plantations) reveals that the lowest average wage rate was in plantation sector (Table 13) which varies from Rs. 84 per day in tea to Rs. 180 per day in rubber sector (Table 14). The irony is that the all India average daily absolute wage rate stood at Rs 241 which is much higher than that of the plantation sector.

Table 13. Average daily absolute wage rates

Sector	**Wages (Rs)**
Manufacturing	303
Mining	367
Plantations	89

Source: Indian Labour Journal

Table 14. Average daily absolute wage rates across plantation sector

Sector	Wages (Rs)
Coffee	110
Tea	84
Rubber	180
Plantations	89

Source: Indian Labour Journal

Although women work force dominates the labour sphere of plantation sector (Table 15), both discrimination and deprivation occurs at various levels which has in a big way resulted in marginalization of the woman plantation labourers. It is also noteworthy that the participation of women in trade union activities has been very much constrained to organizing rather than leadership. On the other hand from the planter's perspective they have no control on the prices of inputs other than labour and therefore, they do exert maximum possible efforts to curb any actions which lead to rise in wage rate.

Table 15. Women workforce across plantations

Coffee	Rubber	Tea	Other plantations	Total
62	37	53	47	53

Source: Labour bureau

Aspects of Environmental and Social Sustainability

As a matter of fact, the large-scale conversion of land to plantations (especially rubber) creates environmental problems such as channelization of rivers, soil erosion, as well as obstructing ecological connectivity for various native and endangered species of plants and animals. Rubber in India has historically been planted in frontier areas which harboured forests and sources of rivers and streams. Today, private rubber plantations are often in areas that are as important as protected areas for long-term conservation, since many wildlife corridors pass through crop production landscapes.

Producing rubber as a single crop is a viable option as long as the prices remained remunerative and marketing arrangements were efficient.

The market uncertainties along with the prevailing contractual arrangements in rubber tapping, and the greater dependence on rubber for livelihoods among the households, appeared to make rubber farming system less viable in the long run. Therefore, the increasing importance of the emerging rubber integrated farming systems assumed greater significance. Evidence showed that various combinations of rubber and other crops or activities amply contributed to the households' capacity for resilience and ensured the sustainability of their livelihoods, in both rubber-growing regions (Viswanathan, 2008). Viewed from this perspective, there is a strong case for further promoting and scaling up the rubber integrated farm livelihood systems in the smallholder dominated rubber-producing regions to make significant and sustainable impacts on smallholder livelihoods.

In the case of tea, there is significant biodiversity loss when high biodiversity areas such as forests are converted to tea plantations. Energy consumption for tea processing is also high which is aggravated by often inefficient and outdated machinery. In India, abundant application of pesticides is also negatively affecting the local and wider environment (water pollution, reduced soil biodiversity). Problematic issues for smallholders include low farm gate prices, poor extension services, limited market channels, poor access to credit and low level of farmer organisation. The Indian tea industry is the second largest employment provider in the organised manufacturing sector giving direct employment to 1.3 million families in the estates (Van der val, 2008). However, there are more numbers of people who also work as casual workers or in the smallholdings and hence the industry indirectly generates employment for another ten million people. Ever since the onset of the price crisis at the end of the nineties, many tea estates have been closed or abandoned because they were deemed to be unprofitable or not profitable enough.

The low rate of literacy and deprived health status among workers always stood as major constraints in giving them access to major health, educational and development initiatives and programmes of the state

machineries and other organisations. Soil fertility is negatively affected by the same plot being used continuously for a single crop and by erosion, which is magnified because tea is often grown on slopes. Both inorganic and organic fertilisers are applied to compensate for this loss. This all leads to a negative spiral in which increasing amounts of agrochemicals are needed in order to maintain production in inverse proportion to the decreasing soil quality. There is a great deal of concentration at the buying end wherein, a handful of companies dominate trade and retail sales. In India, there is consensus among various stakeholders, including buyers, that there is a high degree of collusion that prevails in auctions in order to keep the price down.

There is a need to form strong co-operatives at the small holder's end to move further up in the value chain of tea. Plantation companies should plough the profits generated from the tea industry back into the gardens in reasonable proportions, to make the industry more sustainable as well as profitable. The private tea processing factories should adopt HACCP, ISO 9000 for food safety and quality aspects and should work together to develop a standard for social certification of the processing factories. The government should provide technical and marketing assistance and debt management services to the small and marginalized farmers.

The small holding size of coffee gardens in India is indeed a contemplating factor (Table 16) which detrimentally affects the upward movement of producers in the value chain. Value addition through production of specialty coffees, which requires smaller volumes, may be an attractive alternative proposition for groups of likeminded small growers but here too, there are constraints in terms of the stringent quality requirements and innovative relationship marketing. From the perspective of the small grower, and specifically the small coffee grower, the key issue would be how to create conditions that will transform the nature of his participation in the value chain so as to derive such economic benefits that ensure a sustainable production system and livelihood.

Table 16. Area and share of production of coffee under different holdings in India

S. No.	Size of Holdings (ha)	No of holdings	% to total	Area (ha)	% to Total	Share of production
I	Small Holdings					
	< 2	178585	80.9	144196	37.1	
	2 - 4	27731	12.6	71905	18.5	
	4 - 10	11800	5.3	73642	19.0	
	Sub Total	218116	98.8	289743	74.6	70%
II	Large Holdings					
	10 - 25	1789	0.8	29829	7.7	
	>25	920	0.4	68623	17.7	
III	Sub Total	2709	1.2	98452	25.4	30%
	Total	220825	100.00	388195	100.00	100%

Source: Coffee Board

In cashew plantations of India, a complex nexus of power relations between corporation officials, politicians, traders and village leaders seems to govern the benefits to communities. Employment in plantations is important for women and may provide a source of income over longer periods than other crops and in lean seasons when there is no other agricultural employment. Labour standards and working conditions in cashew processing seem to be deteriorating, particularly for women who represent the overwhelming majority of workers. In Kerala, most public sector factories have closed and in private factories, employers have 'casualised' the workers and the numbers of days of employment per worker have declined over time (Jeyaranjan and Padmini, 2006). Given the choices they face, gender-based inequalities mean that women work for even lower wages than men in poor and health-threatening environments. It is a matter of fact that the Indian cashew industry is affected by a number of social issues such as poor working conditions, health and safety issues. The market is asking for

traceability, transparency and good agricultural practices at farmer level, and the small holder cashew growers are hardly organized. On the other hand, cashew cultivation has a positive ecological impact in that it serves to protect, conserve and restore the soil. Cashew trees will prevent deforestation and are a tool to fight climate change and thereby assumes a very important role in the current regime of climate change. The best way is to improve the overall quality standards, which include the labour standards as well in the lower end of the cashew chain. This is very important since the upper end of the cashew chain is controlled by few global retailers.

Stagnating market prices and increasing cost of production, especially the skilled labour charges in the recent times have generated livelihood concerns of arecanut farmers in India. Surging imports, which is around 12 percent of the domestic production, certainly has a significant role in price stickiness. Market studies reveal that around 75 percent of the arecanut trade is in the hands of private traders, which has provided ample scope for hoarding and resulted in market imperfections and low price realization. A check in additional area expansion and encouraging the farmer to adopt arecanut based cropping system by strengthening the Transfer of Technology (ToT) activities by the state agriculture/ horticulture departments would certainly benefit the arecanut farmers' in long run.

In the case of cocoa, domestic supply chain is still in rudimentary stages. CAMPCO and Cadbury India Ltd (now Mondelez India) are the major procuring agencies, who are directly procuring the cocoa beans from farmers. The value share of the producer/farmer is a meager 32% because most of the farmers sell the produce as wet beans, even without doing minimal processing. Drying yards, primary processing facilities, and storage facilities are lacking in the case of most of the cocoa farmers. Since the stringent food safety standards and trace back systems are evolving in international arena, it is a real challenge to establish robust procuring system in the upstream end of the cocoa value chain in the country. Urgent steps should be taken to establish village level primary processing units and capacity building for fermentation and drying of cocoa beans with the formation of strong farmer aggregates, women

SHG's and rural youths. Development of exclusive market yards and assembling places for cocoa beans along with the adoption of high quality food safety standards would be a pro-active step for better realization of bean prices. Assured buy-back systems developed in the frame of contract farming under the stake of government (tripartite arrangement) can help the growth of the sector.

Conclusion

Given the importance of plantation sector as a foreign exchange earner a vibrant innovation system has been evolved overtime in India. Having said that, it should be noted that, competitiveness was the key aspects kept at the forefront, while environment concerns were not given adequate importance. Overtime, there has been growing concern with its impact on sustainability. Although there had been some appreciable organizational level steps taken towards sustainability (estate to small holders, mono to mixed cropping), there appears to be an institutional inertia such that institutional innovations (rules, laws etc) are not coevolving with organizations innovations. The need of the time is to evolve a sustainability oriented innovation system, wherein various innovations co-evolve in such a way that the plantation sector is made sustainable. The employment potential generated by the intercropping programme is advantageous for the farmers in addition to the diversification of farm production as it opens up greater scope for better employment of the farmer and his family, and thereby strengthens the concept of family farm. The Indian plantation sector has inherent strength of varied agro-climatic conditions, huge domestic demand, highest productivity, strong research and development and ToT systems. However, so far the sector has not effectively utilized the possible linkage between them for increasing the production and marketing efficiencies.

Inclusive growth and sustainability of plantation economy could be achieved through integrated development of cultivation and industry coupled with a stable market. The programmes which has taken a shift in strategy like aggregation of farmers for group activities, collaborative research for production of high yielding and hybrid seedlings, creating more skilled labourers for farming, harvesting and processing operations

along with the objective of triggering production, processing and value addition can place the Indian plantation sector at forefront in the world. Apart from all these, since food safety standards are becoming more stringent in the world, to be competitive in the trade we must give adequate importance to the Good Management Practices (GMP) in the plantation sector.

The small holder perspective in research needs to be emphasized in plantation crops considering the structure of operational holdings in this sector. Technologies appropriate for small holdings need to be developed for faster and wider technology adoption in the crops. The synergy from the developmental efforts of the various institutions that exist for specific purposes and crops need to be channelled through better institutional linkages and cross disciplinary approach to address common challenges in the sector. The gender dimension should be mainstreamed in all programmes.

References

Anoopkumar, M. 2012. Commodity price instability under globalization, National Research Programme on Plantation Development Discussion Paper 13, NRPPD, Centre for Development Studies.

Brigit, J. 2004. Trade Liberalization and Primary Commodity Prices: Empirical Evidence from Select Tropical Crops in Kerala, GTAP No.1537, available at www.gtap.agecon.purdue.edu.

CDB. 2013. Views of Coconut Development Board on the fixation of Minimum Support Price Milling Ball Copra for the Season 2014, Coconut Development Board, Kochi.

Das, P.K. 1991. Coconut based intercropping with cassava: An economic analysis. CORD 7(2), 58-65.

Economic review. 2016. Kerala economic review, published by Kerala State Planning Board, Government of Kerala.

Economic review. 2009. Kerala economic review, published by Kerala State Planning Board, Government of Kerala.

Food and Agricultural Organization. 1996. Production Year Book. FAO, Rome, Italy.

Hayami, Yujiro and Damodaran, A. 2004. Towards an alternative agrarian reform: Tea plantations in South India. Economic and Political Weekly September 4, 2004, 3992-3997.

Hegde, M. R., G Gopalasundaram, P. and Yusuf, M. 1990. Intercropping in Coconut Gardens. Technical Bulletin no. 23, CPCRI, Kasaragod, India.

Jeyaranjan, J., Padmini, S. 2006. Revisiting the cashew industry in India: Combining insights from value chain and "social embeddedness" perspectives. The Indian journal of labour economics : a quarterly journal of Indian Society of Labour Economics. Vol. 49 (4), 625-642.

Joseph, K. J. 2010. Towards a new paradigm for plantation development in India: An analysis of the system of production and innovation from an inclusive growth perspective. National Research Programme on Plantation Development Discussion Paper 1, NRPPD, Centre for Development Studies.

Mani, S and Santhakumar, V . 2011. Diffusion of new technologies and productivity growth in agriculture: Natural rubber vs coconuts. Economic & Political Weekly, 46(6) 58-63.

Nagoor, B.H .2010. Trade aspect of plantation sector of India, National Research Programme on Plantation Development Discussion Paper 8, NRPPD, Centre for Development Studies.

Sahasranaman, K. N., Pillai, N. G., Jayasankar, N. P., Potty, V. P., Thomas Varkey, Kamalakshiamma, P. G., Radha, K. 1983. Mixed farming in coconut gardens: Economics and its effects on root (wilt) disease. In: Coconut research and development (Ed. N.M. Nair), pp: 160-165, Willy eastern limited, New Delhi.

Sairam, C,V., Bosco,S,J,D.,Arulraj,S.,Rajagopal,V.,Prabhu Kumar,S. 2008. Prospects of coconut based agribusiness in India. Financing Agriculture, pp 28-33.

Thamban, C., Arulraj, S. 2007. Coconut-based cropping system for sustainable income. Indian Horticulture, 22.

UNCTAD. 2008. Commodity Price Hikes and Instability, Chapter 2, Trade and Development Report, UNCTAD.

Van der Wal, S. 2008. Sustainability Issues in the tea sector: A comparative analysis of six Leading Producing Countries. Centre for Research on Multinational Corporations, Amsterdam, Netherlands, 108p

Veeramani, C and Saini, K Gordhan. 2011. Impact of ASEAN-India Preferential Trade Agreement on Plantation Commodities: A Simulation Analysis. Economic & Political Weekly, Volume XIVI (10), pp 83-92.

Viswanathan, P.K. 2008. Emerging smallholder rubber farming systems in India and Thailand: A comparative economic analysis. Asian Journal of Agriculture and Development, Vol. 5 (2).

Innovative extension approaches for plantation crops (2016) : 46-53
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Alternative approaches in agricultural extension

Ramachandran, C.

Introduction

Agricultural extension is often perceived as a weak, if not missing link in the technology driven process of agrarian change. Though the veracity of the alleged assertion is a moot point, it indicates the need for taking a relook at the structure, function and the logic of the current extension system in a holistic and historic way so as to contextualize the need for alternative approaches some of which are already in vogue.

Agricultural Extension – logic and praxis of new approaches

Why Extension?

If "extension involves the conscious use of communication of information to help people form sound opinions and make good decisions" (Van den Ban and Hawkins 1996) its relevance goes unchallenged as long as there are people who are deficient in their capacities to help themselves.

Farmers, whether they cultivate grains or cash crops, keep on facing a number of challenges that affect their livelihood security. These challenges can be broadly classified under the following typologies

- Technological challenges
- Institutional challenges
- Behavioural challenges
- Market & Trade challenges and
- Eco-system challenges

It is these very challenges that decide the capacity endowment of

farmers, which in turns decides their well being. As sentinels of food security to the community or the State to they belong to, farmers are responsible to produce enough surplus which can fulfill the food-fibre-fodder needs of the consumer. The surplus, once gains access to the market, becomes commodities and gets back to the producers as monetary compensation or profit, part of which goes as investment into the farming enterprise itself. The cycle goes on. Thus the individual farmer exists as cog in a wheel called a value chain.

Extension was born as an institutionalised answer to the alarming disconnects between the scientific agricultural knowledge system and the farmers. When the new farm technology was conceived as an "end of the pipeline product" the extension process or agricultural extension education was thought of as a technology transfer (TOT) mechanism narrowly built on the principles of Human resource development. In simple terms

Extension = TOT + HRD

The extension process, thus typically, is accomplished through one-on-one consultations with individual farmers, the dissemination of publications; as well as through the hosting of workshops, informal group discussions, conferences, and demonstrations.

The Training and Visit system is a typical example of a public sector (but funded by World Bank) extension approach which had employed this logic of extension in a large scale across many developing countries. The T&V system indeed gave much impetus to the agrarian recovery from a post Green Revolution fatigue in India. But it was not devoid of many pitfalls. The innovation–diffusion model (Rogers, 1962; 2003) which gave a normative framework to this approach also was subjected to criticism.

Paradigm shifts

A large number of studies conducted across the globe under the Innovation –diffusion model revealed that the laggardness in adoption of the modern technology or knowledge could not be attributed to the behavioural deficiencies of the farmer individual. She has her own reasons for not adopting a scientifically correct practice. The attempt to

bridge the "yield gap" (the difference between the potential yield realised under experimental farm conditions and that of the farmer) without having a clear understanding of the ecosystem endowment of the farm vis-a-vis the research farm lead to non-adoption or disenchantment towards the innovation released by the agricultural research system.

Farmer first to Farming systems

This mismatch lead to new attempts to change the way the agricultural technology generation system has been functioning. The "farmer first approach" mooted by Robert Chambers (1989) has been a clarion call in this direction. In fact, what was happening was mainly two kinds of shifts in the whole perspective. One was the shift in the way the farmer's wisdom was located in the research system. When new high yielding varieties and related practices, the green revolution technologies, came out as the success of agricultural sciences the farmer was conceived to be devoid of scientific orientation and her indigenous wisdom of not much pragmatic/commercial value. Another was the shift in the research question. Crop improvement had to be embedded in the wider farming system. It was something like the shift from the Text to its Context.

Farmer was no longer to be considered as a landed individual but more as a member of an organically connected farming community. Thus, the group farming approaches started making economic and sociological sense. The traditionally acquired skills and knowledge of the farmer were soon found to be immense value to be utilised in the development of technologies and knowledge. And farmer was found to be an equally skill- full partner in the extension process. These paradigm shifts were the result of the research work done by extension scientists who tried to answer the challenges faced by the grass root level extension professionals across the world.

The shift in logic found expression and global currency through Farming system research /extension (FSR/E), participatory technology development (PTD) and farmer to farmer extension. PRA /RRA emerged as methodological tools to compliment this process.

Emergence of Cyber extension

The immense opportunities thrown out by Internet-driven revolutions in ICT were soon exploited by extension scientists and found wider acceptance among the farming community. With the increasing penetration of internet in rural areas the digital-divide is becoming a thing of the past. Characterizing today's farmers as "google farmers" is no longer exclamatory.

Privatisation of extension services

Farmers are willing to pay for the extension service provided they are of value to them came as a revelation to the "free-lunch" mindset of public extension functionaries. But privatisation needs to be taken with enough caution so as not to miss the interests of the disadvantaged small and marginal farmers.

Quality conscious consumers

The increasing level of concern for food safety and environmental correctness has unleashed a fragmented market which in turn has sent discretionary signals to the consumer system. Extension system has well taken care of these concerns by developing targeted approaches in the client system.

Gender mainstreaming

There are subtle differences in the technological requirements of women farmers when compared to that of men. There is increasing realisation that the status of women farmers can be bettered if these variations are taken care by the research system as well as the extension system.

Agricultural extension is a contextual, innovation-dependent conscientisation process. It is not mere communication. It is the art and science of helping the stakeholder to help herself by realizing that she is part of the problem as well as solution. The component of agricultural extension namely the process of technology transfer needs to be redefined as a technology, or rather innovation translation process. Though it is difficult to have a consensus on an ontological definition of extension (the what question) it is worth to keep in mind what it is NOT (Ramachandran, 2004).

- Extension per se is not a panacea for all our problems in the fanning sector. It is just one of the many factors (market forces, credit system, policy climate, resource base) that facilitate development.
- Extension is not TOT alone. It includes Human Resource Development (HRD) also. This necessitates the need for the extension agent to acquire more social science skills (community mobilization, conflict management, problem solving. etc), than mere knowledge about the technology being transferred.
- Extension does not take place in a political vacuum. Nor does the technology generation system too.
- Extension is not an alibi for an ill-validated technology. The rejection of technology by the farmer is not an irrational decision. It simply means that there is incongruence between his/her needs or the resource endowment and the technological promise.

Extension systems in India – A Glimpse

With different extension systems /approaches in vogue, India maintains a philosophy of pluralism to cater the multifaceted and contextual needs of its huge farmer client sector. It is worth noting that the seven–decade old Ministry of Agriculture was renamed in 2015 as "Ministry of Agriculture and Farmers' Welfare" with a view to take care of the farming community's needs as well as the personal problems faced by them. The "farmer first" paradigm is the spirit behind the new move of the government. The budgetary support of the KVK network has been increased and linkages with the private sector in service oriented extension activities are on an encouraging rise. With the establishment of State Agricultural Management and Extension Training Institutes (SAMETIs), the ATMA model in India is getting a further fillip.

A timeline of major extension innovations attempted after independence are given below:

Post-Independence Innovations in Indian Agricultural Extension

Community Development

1952 Community Development Programme (CDP)

1953 National Extension Service (NES)

1954 Community Development Block (CDB)

1957 Panchayati Raj (Democratic Decentralization)

Technological Development

1960 Intensive Agricultural District Programme (IADP)

1964 Intensive Agricultural Area Programme (IAAP)

1964-65 Intensive Cattle Development Project (ICDP)

1966 High Yielding Variety Programme (HYVP)

Development with Social Justice

1970-71 Small Farmers Development Agency (SFDA)

1970-71 Marginal Farmers' and Agricultural Labourers Programme (MF & ALP)

1970-71 Drought Prone Area Programme (DPAP)

1972-73 Pilot Project for Tribal Development

1974 Training & Visit System (T & V System)

1978-79 Integrated Rural Development Programme (IRDP)

1979 Training of Rural Youth for Self Employment (TRYSEM)

1980 National Rural Employment Programme (NREP)

1982 Development of Women and Children in Rural Areas (DWCRA)

1983 National Agricultural Extension Project (NAEP)

1986 Technology Mission on Oilseeds (TMO)

1989 Jawahar Rojgar Yojna (JRY)

1993 Employment Assurance Schemes

1994 Small Framers Agri-Business Consortium (SFAC)

1999 Swarnjayanti Gram Swarozgar Yojna

Indian Council of Agricultural Research/Technology Transfer Projects/ Services

1974 Krishi Vigyan Kendras

1974-75 Operational Research Projects

1979 Lab to Land Programme

1995-96 Technology Assessment and Refinement through Institute Village Linkage Programme (TAR-IVLP)

1998-03 National Agricultural Technology Project-Innovations in Technology Disseminations (NATP-ITD)

2002-07 Continued as "Support to State Extension Programmes for Extension Reforms"

2004 Kisan Call Centre

2007-12 National Agricultural Innovation Project (NAIP)

Private Sector Advisory Services

Private sector by way of input sale by agri-business companies is showing a big presence in India. There are over 280,000 input supply firms, but many do not have sufficient knowledge and experience in providing good advisory services to farmers. At first, the public and private sector did not want to work together but through the ATMA approach, the public and private sector started working together and then, in 2004, the National Institute of Agricultural Extension Management (MANAGE) started training and giving diplomas to the participants from these private sector firms, especially in Andhra Pradesh. Most of the agri-business companies in India attempted various business models in the field of agriculture and allied sectors. These models include transfer of technology with market support. Each model is unique in its own way. Some of the successful models are:

- E-Choupal http://www.echoupal.com/
- Mahindra Shubhlabh, Mahindra-Smridhhi http://www.mahindra.com/
- Chambal Uttam Bandhan http://www.indiamart.com/chambal-fertiliserschemicals/
- Tata Kisan Kendra http://www.tatakisansansar.com/
- EID Parry http://www.eidparry.com/

Extension service through Commodity boards

There are different Commodity Boards currently operating in India, including: Central Silk Board (CSB), Coconut Development Board

(CDB), Coffee Board, Coir Board, Rubber Board, Spices Board, Tea Board, Tobacco Board, National Dairy Development Board (NDDB), National Horticulture Board (NHB), Cashew Export Promotion Council (CEPC), National Jute Board (NJB), and the National Federation of Cooperative Sugar Factories (NFCSF) .

Conclusion

Agricultural extension is a highly contextual and continuously evolving process fundamentally latched on the dynamic trajectory by which agricultural science and technology shapes the forces of agrarian change. In fact, the conventional notion of extension as an add-on appendage of the knowledge/technology generation process is being challenged and the discourse is getting manifested as alternative approaches. The emergence of ICT driven value chains, erosion of public funded support systems and concerns for ecosystem sustainability are some of the new drivers fostering the quest for the alternatives. The extension professionals have a responsibility not to miss the ethical dimensions while navigating in a neoliberal context of welfare oriented delivery of their services.

References

Van den Ban and Hawkins .1996. Agricultural Extension Wiley Blackwell, 294p.

Chambers, R. 1989. Farmer First: Farmer Innovation and Agricultural Research, ITDG Publishing, 240 p.

Ramachandran, C. 2004. Teaching Not to F(in)ish: A constructive perspective on reinventing a Responsible Marine Fisheries Extension System, CMFRI, Kochi

Rogers E M. 2003. Diffusion of Innovations, Free Press New York

Singh. 2014. In-depth Study of the Pluralistic Agricultural Extension System in India MPRA paper 59461

Innovative extension approaches for plantation crops (2016) : 54-66
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Participatory technology development (PTD): Concept and practice

Shanmugasundaram, B., Moosa, P. P. and Chitra Parayil

Introduction

Agricultural Research in India has to address new challenges like global competitiveness, sustainability, environmental conservation, social equity etc. The focus then will be on market driven research with significant emphasis on stakeholder interests. This calls for gradual shift in our approaches to agricultural research in general and agricultural technology development and diffusion in particular. Hence research approach should be from the conventional subject specific research to multidisciplinary, collaborative and Participatory Technology Development (PTD).

Agricultural technology needs to be developed keeping the farmers livelihoods at the centre of the innovation process. In order to be useful to the farmers, the technology needs to be rooted in their natural, social and cultural reality. Scientist, Extension professionals and other extension providers are outsiders to a community; hence there is need for involvement of farmers in the process of technology development.

Weakness in the present approaches to agricultural research and extension

The conventional approach to agricultural research and extension has often been criticized for its top down nature. This approach has led to the technology recommendations that are too general ignoring the multiple farming situations within a farming situation. Participatory approaches offer readymade solutions to this problem. Hence, of late there is growing awareness globally on the use of participatory

approaches in agricultural research and development.

Salas *et al.*, 2003 explained about Participatory Technology Development as described below:

Participatory: Involving and empowering local people

Technology: Based on local people's knowledge and practical methods of experimentation

Development: People-centered sustainable agricultural development based on technologies generation from within.

Participatory Technology Development is a form of informal small–scale farming system Research. This research type focuses on improving small-scale farmer's production systems on household level and on reducing rural poverty. PTD's core objective is testing technologies under farmers' conditions, on farmers' fields in order to find locally adapted agricultural technologies for broad dissemination (Zahumensky, 2014)

History of PTD

Conroy and Sutherland (2004) mentioned that during 1970s and 1980s there was growing recognition that agricultural research had primarily benefited resource-rich farmers, and that the main reason why resource poor farmers had been slow or unable to adopt recommendations was that the technologies were not appropriate for them. This recognition contributed to the emergence of the Farming System Research (FSR) movement in the 1970s. This was soon followed by growth of Farmer Participatory Research (FPR) and Participatory Technology Development (PTD) during the 1980s and 1990s. A broad representation of specific documented efforts in this direction is given in Table 1.

Table 1. Evolution of participatory approaches

FSR	Farming system Research (Mellor,1966; Collison,1972; Norman,1974)
ITK	Indigenous Technical Knowledge (IDS,1979;Brokesha *et al.*,1980)

OFT	On –Farm trials (Tripp,1982)
FBTF	Farmer back to farmer (Rhodes and Booth,1982)
FFL	Farmer first and Last (Chambers and Gildyal,1985)
FPR	Farmers PTD (Farrington and Martin,1987)
OFCOR	On farm Client Oriented Research (Merill-Sands *et al.*,1990)
IBA	Interactive Bottom-up Approach (Bunders *et al.*, 1990)
RRA	Rapid Rural Appraisal (IIED, 1991)
PRA	Participatory Rural Appraisal (IIED, 1991)
PTD	Participatory Technology Development (Reintjes *et al.*,1992)

The above are a few documented and published approaches in PTD. In addition, a wide diversity of undocumented efforts in the field practices also exists in developing countries. The list is growing as a result of increasing farmer involvement in problem identification and technology testing and ultimately, the support of farmers in agricultural research.

Elements of PTD

Farmers' experiments are generally one of three types (Rhoades and Bebbington, 1991 as described by FAO):

Curiosity Experiment: Trying out a new idea purely out of curiosity

Problem-Solving experiments: Testing possible solutions to old and new problems

Adaptation Experiment: Testing a new technology or modifying an existing one to see if it works within the known environment.

Comparison between Research Stations Vs Farm Holdings and Scientists Research Vs Farmers Research provide a vivid picture how PTD is different and important than other systems, as mentioned below:

Parameter	**Research Stations**	**Farm Holdings**
Resources	Abundant & Assured availability	Limited & Availability not assured

Seed	High quality	Quality not certain
Capital	Not a constraint	Limited factor
Irrigation	Under own control	Mostly under control of others
Labour	No limit	Very much limited
Price	Not a critical factor	High input cost & Low price for produce
Technical skills	Always available	Limited availability

Scientist Research	**Farmers Research**
Use more capital-intensive equipment	Limited equipment , use local resources
Long term perspective	Short term perspective
Complicated design and analysis	Simple farmer decided design
Standard procedure	Changing procedures. According to adhoc needs
Focus on single crop	Integrated system
Oriented to general consumer preferences and market	Local preferences and markets
Controlled variables	Follow farmers management practices
Artificial situation	Real life situation

Four distinct approaches to PTD could be identified based on the above documented efforts. They are:

- The first approach (eg. FSR, ITK and FFL) revolves around understanding farming systems. This is a move away from looking only at commodity crops to a more holistic perspective. This approach shows that farming systems are not static but dynamic.
- The second approach (eg. OFT, FBTF and FFL) emulates the physical conditions of farmers in on-farm research. This approach addresses the fact that conditions in laboratories and research stations are vastly different from actual field conditions.

- The third approach (eg. IBA and OFCOR) revolves around the emulation of the personal and physical conditions of farmers. This is based on farmers' rationality ie., farmers decisions and practices are not only in response to physical factors but are also due to socio-economic factors.
- The fourth approach combines analytical tools geared toward action. FPR, PRA and PTD involve methodologies that not only combine the understanding of farmers' physical and personal conditions but also provide the tools necessary for farmers to participate in the research process.

A perusal of the above approaches reveals that the differences among farmers have to be recognized and all the groups need to be integrated including a gender perspective in agricultural research to make it truly participatory.

PTD related concepts

Some of the concepts related to PTD are given below:

Farmer Participatory Research

This is a PTD close related concept in which farmers participate in the research process with scientists. Research questions are found out together with selected farmers or the whole village and villagers will do and monitor experiments with scientists. This is a promising approach for applied research. However, it is still different with PTD in limitation of dissemination and lack of extension system.

Farmer led research: When academic research originated from scientist are difficult to be applied and transferred into reality, attention must be paid to do research which meet the real needs of farmers or solve problems farmer household face.

Participatory action research: This concept is quite close with farmer led research. Here research is done based on the needs of farmers and research results must be able to be applied by farmers.

Participatory on farm research: Research which is difficult to do in labs or experimental stations suggests scientists to move to farmers and their farms. Scientists carry out their research on farms to find out

appropriate solutions for cultivation with the hope that the research results will be applied and disseminated to other farms nearby which have similar conditions.

Farmer field school: This is an extension approach based on experiences and knowledge of local farmers in agriculture. Farmer field school lasts along with the growth cycle of a crop. FFS includes comparison of traditional production with recommendations drawn from experiments. The experiences gained from the first experiment in the school will guide farmers to develop other experiments in the future.

When to apply PTD?

The cases when PTD need to be applied are:

- When farmers' have a problem but do not have any available solutions to solve. This fact occurs quite often in production and natural resources management. Farmers or communities can face difficulties and themselves they have not found out yet solutions to overcome. In this case, PTD is an opportunity for researchers, extensionists and farmers together to find appropriate ways through experimenting different solutions.
- When farmers have an idea on something new but it needs to be experimented. During the productions process, farmers often have new ideas to improve their cultivation and natural resources management activities. However, how to make idea become real is still not very clear to them. There is also a space for PTD in which researchers and extensionists help farmers design and organize new experiments.

Activities of a PTD project

The key part of PTD is experimentation and evaluation. However for the effectiveness of these core activities some preliminary as well as following activities are necessary.

1. Relationship

- Building relationship of confidence that aim at cooperation with local networks

- Preliminary situation analysis
- Awareness mobilization

2. Diagnosis

- Identification of farmer's problems and prioritization of problems
- Identification of ITK and scientific knowledge
- Screening, selection of topics and criteria

3. Planning /Design

- Revising experimental practice
- Planning and designing experiments
- Designing evaluation tools for experiments

4. Implementation/Experimentation and Evaluation

- Implementation of formal/informal experiments, based on farmers criteria but improved with methodological suggestions from outsiders
- Measurement, evaluation of results and validation of informal experiments

5. Dissemination

- Communication of results
- Training in skills, proven technologies and use of experimental methods

6. Consolidation

- Creation of favourable conditions for ongoing experimentation
- Creation of institutions, physical infrastructure, capacity building, supplies and support services for promotion

PTD exposition

A PTD-exposition offers a platform for broad exchange and discussion about PTD experiences across village borders at the end of a PTD project cycle. Furthermore, it increases the team spirit among PTD

farmers, sensitizes for the potential of local indigenous knowledge and for the power to induce change through participatory experimentation.

Benefits from participation by farmers in the process of technology development

Gonsalves *et al.*, 2005, enlisted the following benefits resulting from participation by farmers in the process of Technology Development

- Improved understanding by scientists of the needs of small farmers, leading to better identification of problems appropriate for adaptive and on farm research
- Improved feedback on farmer's needs and objectives to guide applied research in research stations
- Accelerated transfer and adoption of improved technology by small farmers
- Efficient, cost effective use of scarce resources in on-farm research through better linkages among farmers, researchers and extensionists
- Development of organizational models, professional skills and values appropriate for demand driven, problem oriented technology design

Obstacles in PTD

Sontakki (2010) has reported that there are lot of obstacles from the scientist and farmer point of view in implementation of PTD. Although convinced of the importance of PTD, scientists generally may be hesitant to involve farmers because

- They are concerned that results could be spoiled by mismanagement of factors outside the researchers' control
- The failure of technologies in farmers' fields may be construed as demonstration of inadequacies of scientists. Therefore, scientists prefer 'finished' and well tested technologies
- Scientists are afraid of exposing farmers to too many uncertainties, in terms of economic, health and environmental damages
- Lack of participatory theory in the practice of analytical research
- Lack of skill and experience in PTD

- Scientist may lack time, motivation and the communication skills to approach farmers

On the other side farmers may be unwilling to participate because:

- They are concerned that research would take too much time and would be too great a risk in their production system.
- They fear that they may be punished if the technology fails
- They may have no intention to experiment an option, which they consider risky, insignificant, or having delayed benefits.
- They may lack communication link with scientists. In many cases, farmers feel that their problems are unimportant to scientists.

Future Challenges for PTD

Sutherland *et al.*, 1998 noted the following challenges in PTD

Cost effective scaling up: Most PTD projects have been resource intensive, but limited in geographical scope. How can successful approaches and activities be scaled up with much less resource intensive inputs?

Institutionalizing PTD: In spite of some success, PTD often reminds marginal. How can PTD be further legitimized and institutional attitudes made more receptive?

Simplifying PTD: How can the prevailing PTD jargon and rhetoric be demystified and the approach simplified?

Farmer Empowerment: PTD is generally orchestrated by professionals. How can low income farmers be empowered to influence the formal research process?

Managing change: Farming systems are in a constant state of change. How can PTD teams be best equipped to identify and respond to emerging research opportunities which require new technical expertise?

Training for PTD: Implementation of PTD requires skills, perspectives and orientation often not included in the academic training of agricultural research scientists, including communication,

community development, qualitative research, farming/livelihood system analysis, gender analysis, design and management of on-farm trials and participatory monitoring and evaluation. How can we equip mature research scientist with these skills so that they can have confidence in them and begin to apply them in ways which are not mechanistic?

Case study on technological interventions for the management of coconut Root (wilt) in PTD mode

Root wilt disease is prevalent in Kerala for nearly 100 years has made sporadic appearance in Eastern Palakkad district of Kerala. Survey of the occurrence of disease was conducted in Palakkad district of Kerala along the border areas of Kerala and Tamil Nadu by cluster sampling technique. A sample of 20 farmers having a total of 8400 trees was selected. It was seen that Root wilt symptoms were noticed in 1615 trees with varying intensity. Other problems like bud rot and stem bleeding were also noticed. The reduction in the yield due to the prevalence of disease ranges from 10 per cent to 80 per cent. Based on the multi-disciplinary diagnostic team visit general and site specific recommendation incorporating organic and inorganic amendments involving farmers were made in a participatory mode. Organic practices include application of Farm yard manure, neem cake, humic acid, Metarrhizium application, use of traps, root feeding of coconut tonic and growing of cover crop like cow pea around the basin. The inorganic methods include NPK recommendations in varying proportion and use of micro nutrients like Magnesium sulphate, Zinc sulphate and Borax. The farmers were involved in the PTD process starting from diagnosis of the problem to experimentation of different treatment practices. The results of the demonstration showed reduction in the spread of disease and increase in the number of green leaves from greenish yellowing and reduction in the nut loss. The intensity of the disease is more visible during summer season when adequate nutrient uptake was not possible. It may be concluded that farmers' participation in the implementation of programme was crucial for the management of root wilt disease.

References

Behera, U. and Sharma, A. 2008. Modern concepts of Agriculture. Farming systems. Indian Agricultural Research Institute, New Delhi.

Bessette, G. 2005. Participatory Development Communication: Reinforcing the Participatory NRM Research and Action process. In: Gonsalves, J. *et al.*, (Eds.): Participatory Research and Development for Sustainable Agriculture and Natural Resource Management: A source book .Understanding PR+D, Laguna, 94-103.

Chambers, R. And Gildyal, B.P. 1985. Agricultural Research for resource poor farmers-The farmers first and last model. Agricultural Administration and Extension 20: 1- 30.

Collinson, M. P. 1972. Farm Management in Peasant Agriculture, Praiger, New York.

Conroy, C. and Sutherland, S. 2004. Participatory Technology Development with resource poor farmers: maximizing input through the use of recommendation domains. AgREN network paper, 133, January, 2004. Overseas Development Institute, London.

Cramb, R. 2005. Rethinking the development, dissemination and adoption of agricultural technologies. In: Gonsalves, J. *et al.*, (Eds.): Participatory Research and Development for Sustainable Agriculture and Natural Resource Management: A source book. Understanding PR+D, Laguna, 145-150.

Farrington, J. and Martin, N. 1987. Farmer participatory research: A review of concepts and practices. ODI discussion paper, 19, Overseas Development Institute.

Gonsalves, J., Becher, T., Braun, A., Campilan, D., De-chavenz, H., Fajber, E., Kapirri, M., Rivaca-Caminade, J. and Vernooy, R (eds.). 2005. Participatory research and development for sustainable agriculture and Natural Resource Management: A source book. International Potato Center- Users perspectives with Agricultural Research and Development and International Development Research Centre, Laguna, Philippines and Ottawa,

Canada.

Horne, P. and Stur, W. 1998. Participatory approaches to agricultural technology development in sloping lands. Extension Bulletin, 462. Food and Fertilizer Technology Center, Taipei.

Horne, P. and Stur, W. 2005. Developing Agricultural Solutions with Small holder Farmers: How to get started with Participatory Approaches. In: Gonsalves, J. *et al.*, (Eds.): Participatory Research and Development for Sustainable Agriculture and Natural Resource Management: A source book .Understanding PR+D, Laguna, 172-180.

IDS. 1979. Rural Development: Whose knowledge counts?. IDS Bulletin, 10.2. IDS, Brington.

IIED. 1991. Farm participatory research in North Ethiopia. Report of training course in Rapid Rural Appraisal for local level planning, IIED, London,

Linquist, B., Keoboualpha, B.H. and Lai, C. 2005. Upland Research in Lao PDR: Experiences with participatory Research Approaches. In: Gonsalves, J. *et al.*, (Eds.): Participatory Research and Development for Sustainable Agriculture and Natural Resource Management: A source book. Doing PR+D, 3, Laguna, 58-65.

Mellor, J.W. 1966. The Economics of Agricultural Development. Cornell University press, Ithaca, New York.

Meril – Sands, D., Kaimowitz, D., Sayce, K., and Chater, S. 1990. The technology triangle: Linking farmers, technology transfer agencies and agricultural researchers. The Hague, ISNAR.

Norman, B.W. 1974. Rationalizing mixed cropping under indigenous conditions: The example of Northern Nigeria. Journal of Developmental Studies, 11: 3-21.

Rhodes, R.F. and Booth, R.H. 1982. Farmer back to farmer: A model for generating acceptable agricultural technology. Agricultural Administration 11:127-137.

Reintjes., Haverkot, B., and Waters- Bayer, A (eds.). 1992. Faring for the future: An extra duration to low external input and sustainable agriculture, Macmillon, London.

Rhoades, R. E. and Bebbington, A. 1991. "Farmers who Experiment-Untapped resource for Agricultural Research and Development, "In Indigenous Knowledge Systems: The Cultural Dimension of Development". D.M. Warren, D. Brokensha and L. JanSlikkerveer (eds). London, Kegan Paul International.

Salas, M., Jianchu, X., and Tillmann. 2003. Field Manual Participatory Technology Development (PTD): Linking Indigenous Knowledge and Biodiversity for Sustainable Livelihoods (2ndEd). Yunnan Science and Technology Press, Kunming.

Sontakki S. Bharat 2010. Participatory Technology Development. Resource material for Foundation Course for Agricultural Research Service. NAARM, Hyderabad.

Sutherland, A., Martin, A., and Salmon, J. 1998. Recent experiences with Participatory Technology Development in Africa. Intermediate Technology press of Oceans Development Institute, London.

Tripp, R. 1982. Data collection, site selection and farmer participation in on-farm experimentation. CIMMYT Economic Progress working paper 82/1, CIMMYT, Mexico, 29 pp.

Zahumensky, Y. 2013. Evaluation of Participatory Tools: Case study about Participatory Technology Development (PTD) in Central India. M.Sc. (Ag.) Thesis, Research Institute of Organic Agriculture, University of Tubingen.

Innovative extension approaches for plantation crops (2016) : 67-96
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Participatory rural appraisal techniques for formulating developmental programmes for plantation crops

Jaganathan, D., Thamban, C., Sivakumar, P. S., Sheela Immanuel and Prakash, P.

Introduction

Plantation crops are the important segment of the horticulture crops and the mainstay of agrarian economies in many states of India. They provide direct and indirect employment to a large number of people in the country. The major plantation crops in India include coconut, arecanut, oil palm, cashew, tea, coffee, rubber and cocoa. Plantation sector in the country is dominated by millions of small and marginal farmers and mainly confined in the economically and ecologically vulnerable regions, plays a crucial role as far as the issue of sustainability is concerned. In the present context, the major challenge is to develop an equitable and sustainable plantation sector ensuring the inclusive growth and at the same time being internationally competitive. Hence the research, extension and development policies and programmes demand appropriate strategies for implementation.

Participatory approaches have been attempted in various plantation crops for formulating effective and viable extension strategies for the sustainability of the sector. Participatory rural appraisal (PRA) is a set of participatory and largely visual techniques for assessing group and community resources, identifying and prioritizing problems and appraising strategies for solving them.

1. Participatory rural appraisal (PRA)

1.1 Concept of PRA

Participatory Rural Appraisal (PRA) is a popular and effective approach to gather information in rural areas. PRA is intended to enable local communities to conduct their own analysis and to plan and take action (Chambers, 1989). PRA involves project staff learning together with villagers to conduct systematic analysis village resources, structures and processes that affect their utilization, livelihood strategies and outcomes, problems and opportunities of the village. The aim of PRA is to help strengthen the capacity of villagers to plan, make decisions, and to take action towards improving their own situation.

PRA is a methodology of learning rural life and their environment from the rural people. It requires researchers / field workers to act as facilitators to help local people conduct their own analysis, plan and take action accordingly. It is based on the principle that local people are creative and capable and can do their own investigations, analysis, and planning. The basic concept of PRA is to learn from rural people. Chambers (1992) has defined PRA as an approach and methods for learning about rural life and conditions from, with and by rural people. He further stated that PRA extends into analysis, planning and action. PRA closely involve villagers and local officials in the process.

There are five key principles that form the basis of any PRA activity which are given below.

- **Participation**: PRA relies heavily on participation by the communities, as the method is designed to enable local people to be involved, not only as sources of information, but as partners with the PRA team in gathering and analyzing the information.
- **Flexibility**: The combination of techniques that is appropriate in a particular development context will be determined by such variables as the size and skill mix of the PRA team, the time and resources available, and the topic and location of the work.
- **Teamwork**: Generally, a PRA is best conducted by a local team (speaking the local languages) with a few outsiders present, a significant representation of women, and a mix of sector specialists

and social scientists, according to the topic.

- Optimal Ignorance: To be efficient in terms of both time and money, PRA work intends to gather just enough information to make the necessary recommendations and decisions.
- Systematic: As PRA-generated data is seldom conducive to statistical analysis (given its largely qualitative nature and relatively small sample size), alternative ways have been developed to ensure the validity and reliability of the findings. These include sampling based on approximate stratification of the community by geographic location or relative wealth, and cross-checking, that is using a number of techniques to investigate views on a single topic (including through a final community meeting to discuss the findings and correct inconsistencies).

1.2 PRA team

The PRA team consists of a Team Leader, facilitator and note-taker. The team leader is responsible for conducting PRA and he plans and implements PRA, manage discussions, interpret and communicate the results. The facilitator conducts focus groups, the drawing of a

map or any other PRA tool. The note taker writes down all important information and relevant observations.

1.3 Before field work

Before conducting PRA in the village, the list of households may be collected from govt. offices to select respondents. PRA materials like charts, sketch pens, chalk, dusters, etc need to be arranged before visiting village. Secondary data are important for background information before conducting PRA exercise. Therefore, a careful review and assessment of the secondary data are necessary from secondary sources before fieldwork. It may be helpful in developing topics, sub-topics or checklists to be used in acquiring information.

The information on Village map, location (taluk, district, state), longitude and latitude, rainfall, population, literacy rate, area and production of major crops, number and production of livestock and fish, cultivable and waste lands, hazards and shocks (drought/ cyclone,

disease prevalence etc), malnutrition status can be collected from government agencies like Directorate of Agriculture/ Horticulture/ Tribal Welfare and also from ATMA/ KVKs. Other sources like newspaper, magazine, published research data etc can also be consulted.

This information may be collected before proceeding for village level data collection as it will help us to triangulate the data collected. Before proceeding with the PRA exercise in the village, it is essential to review the data sets compiled in light of identifying the information gaps.

The team members should also discuss how to carry out field works, especially PRA tools to be applied for collecting the required information. Generally, the choice of tools depends on topics and expected output. The team should consider the situation and select the tools which fit better for collecting reliable and precise information. Therefore, it is the team that decides which tools and techniques fit better for a particular area.

It is preferable to go for a short field visit to identify key informants, to observe the initial site and to try out the tools. This preparation may be assigned to a single team member who is familiar with the locality. Based on the short field visit, the pre-designed tools may have to be changed or modified.

1.4 Rapport building with villagers

Rapport building is an important task for the team for collecting reliable information. It is usually done to develop communications and to establish working relationships with the local people. Generally, rapport building is initiated immediately as the team enters a village. This may help the team to bring closer to the village people. The team should follow the following steps suggested by Pokharel (1998) for conducing PRA in rural areas:

- Start talking to the rural people saying - Hello" whenever you meet them..
- Treat and respect rural people as per their local custom
- Try to meet with local leaders and officials before starting work in a village

- Clearly explain reasons for coming to the area
- Show genuine interest in the local issues
- Choose time and venue that are convenient for the local people

1.5 Community mapping

Community mapping is one of the most versatile tools and is powerful in generating pictures on any aspect of the physical reality. Usually mapping is done by the villagers themselves with the help of PRA team to spatially depict village agro-ecosystems, resources, social structure, technology adoption and vulnerability without accurate scale. They are powerful ice-breaking' exercises at the beginning of PRA exercise and also act as invaluable visual reference for discussions with people about the village livelihood systems.

Usually the maps are drawn on the ground using on the spot available materials like chalk, rangoli powder, leaves, flowers, twigs etc. The location of the mapping session should be freely accessible to all groups of the community (e.g. different casts, men and women, rich and poor, etc.) like community meeting hall etc. The guidelines for drawing maps are given below:

Guidelines

Before:

- Decide what type of map you want
- Involve 5-10 Key Informants who will have some knowledge about the area and can contribute, in every map
- Choose suitable time and place – preferably community meeting place
- Bring all the materials with you on which you can copy a map drawn on the ground.

During:

- Encourage by asking open questions
- Encourage the use of different materials, i.e. flowers, stones, twigs, sticks etc
- Be patient!

After:

- Make a copy of the map or model, including mapper's names
- Try drawing the same type of map with different groups of people i.e. one group of women, a group of old men and the young
- Keep it simple and orient it appropriately
- Cross-check the map, compare with what you see

2. PRA tools and techniques:

The commonly used PRA tools and techniques are given below.

Direct observation: Observations are related to questions: What? When? Where? Who? Why? How?

Do it yourself: Villagers are encouraged to teach the researcher how to do various activities. The researcher will learn how much skill and strength are required to do day -to- day rural activities, gaining an insider's perspective on a situation. Roles are reversed: villagers are the "experts" and attitudes are challenged.

Participatory mapping and modelling: Using local materials, villagers draw or model current or historical conditions. The researcher then interviews the villager by "interviewing the map." This technique can be used to show watersheds, forests, farms, home gardens, residential areas, soils, water sources, wealth rankings, household assets, land-use patterns, changes in farming practices, constraints, trends, health and welfare conditions, and the distribution of various resources.

Transect walks and guided field walks: The researcher and key informants conduct a walking tour through areas of interest to observe, to listen, to identify different zones or conditions, and to ask questions to identify problems and possible solutions.

With this method, the outsider can quickly learn about topography, soils, land use, forests, watersheds, and community assets.

Seasonal calendars: Variables such as rainfall, labor, income, expenditures, debt, animal fodder or pests, and harvesting periods can be drawn (or created with stones, seeds, and sticks) to show month-to-month variations and seasonal constraints and to highlight opportunities

for action. An 18-month calendar can better illustrate variations than a 12-month calendar.

Daily-activity profiles: Researchers can explore and compare the daily-activity patterns of men, women, youth, and elders by charting the amount of time taken to complete tasks.

Semi structured interviewing: A semi structured interviewing and listening technique uses some predetermined questions and topics but allows new topics to be pursued as the interview develops. The interviews are informal and conversational but carefully controlled.

Types, sequencing, and chain interviews: Individual, pair, and group interviews are combined in a sequence to take advantage of key informants and specialist groups.

Permanent-group interviews: Established groups, farmers' groups, or people using the same water source can be interviewed together. This technique can help identify collective problems or solutions.

Time lines: Major historical community events and changes are dated and listed. Understanding the cycles of change can help communities focus on future actions and information requirements.

Local histories: Local histories are similar to time lines but give a more detailed account of how things have changed or are changing. For example, histories can be developed for crops, population changes, community health trends and epidemics, education changes, road developments, and trees and forests.

Local researchers and village analysts: With some training, local people can conduct the research process (for example, collect, analyze, use, and present data; conduct transects; interview other villagers; draw maps; make observations).

Venn diagrams: To show the relationship between things, overlapping circles are used to represent people, villages, or institutions; lines are added to reflect inputs and outputs.

Participatory diagramming: People are encouraged to display their knowledge on pie and bar charts and flow diagrams.

Wealth and well-being rankings: People are asked to sort cards (or slips of paper) representing individuals or households from rich to poor or from sick to healthy. This technique can be used for crosschecking information and for initiating discussions on a specific topic (for example, poverty). The technique can also be used to produce a benchmark against which future development interventions can be measured or evaluated.

Direct-matrix pair-wise ranking and scoring: Direct-matrix pair-wise ranking and scoring is a tool used to discover local attitudes on various topics. People rank and compare individual items, using their own categories and criteria, by raising hands or placing representative objects on a board. For example, six different shrubs can be ranked from best to worst for their fuel, fodder, and erosion-control attributes. Other resources can be ranked in terms of taste or marketability. Wealth ranking can be used to identify wealth criteria and establish the relative position of households.

Matrices: Matrices can be used to gather information and to facilitate or focus analyses and discussions. For example, a problem opportunity matrix could have columns with the following labels: soil type, land use, cropping patterns, and available resources; and rows with the following labels: problems, constraints, local solutions, and initiatives already tried.

Traditional management systems and local-resource collections: Local people collect samples (for example, of soils, plants). This can be an efficient way to learn about the local biodiversity, management systems, and taxonomies.

Portraits, profiles, case studies, and stories: Household histories or stories of how a certain conflict was resolved are recorded. This can provide short but insightful descriptions of characteristic problems and how they are dealt with.

Folklore, songs, poetry, and dance: Local folklore, songs, dance, and

poetry are analyzed to provide insight into values, history, practices, and beliefs.

Futures possible: People are asked how they would like things to be in 1 year and to predict what will happen if nothing is done or if something is done. People's desires, wishes, and expectations are revealed.

Diagrams, exhibition: Diagrams, maps, charts, and photos of the research activity are displayed in a public place to share information, facilitate discussions, and provide an additional crosschecking device. The exhibition can inspire other villagers to take part in research activities.

Shared presentations and analysis: Participants are encouraged to present their findings to other villagers and to outsiders, providing another opportunity for crosschecking, feedback, comment, and criticism.

Night halts: The researchers live in the village during the research process. This facilitates all interactions between the outsiders and the villagers, invites change in the outsiders' attitudes, and allows for early-morning and evening discussions, when villagers tend to have more leisure time.

Short questionnaires: Short and issue-specific questionnaires can be useful if conducted late in the research process.

Field report writing: Key findings are recorded before "leaving" the village. (This assumes that the community has consented to having the research data leave the village). Brief summaries are made of each diagram, model, and map, as well as of the process involved in creating them.

Survey of villagers' attitudes toward PRA: To improve the PRA process and techniques and maintain realistic expectations, the researcher asks the villagers what they expected and what they learned from the PRA research process.

Intriguing practices and beliefs: Indigenous practices and beliefs are noted, even if they are based on myth or superstition. Even practices

that are unusual or don't fit in with conventional scientific thinking are worth exploring because they are meaningful to local people.

3. PRA tools for plantation crops

The most important PRA tools which are used for formulating viable extension strategies for the development of plantation sector are described below.

3.1 Village boundary map

Description: The village boundary or base map visually depicts the village boundaries and neighboring villages (Fig 1.). It provides a 'bird's eye view' of the village and its surrounding lands. It shows important landscape features like rivers, hills, houses, roads, irrigation canals and the borders of village lands.

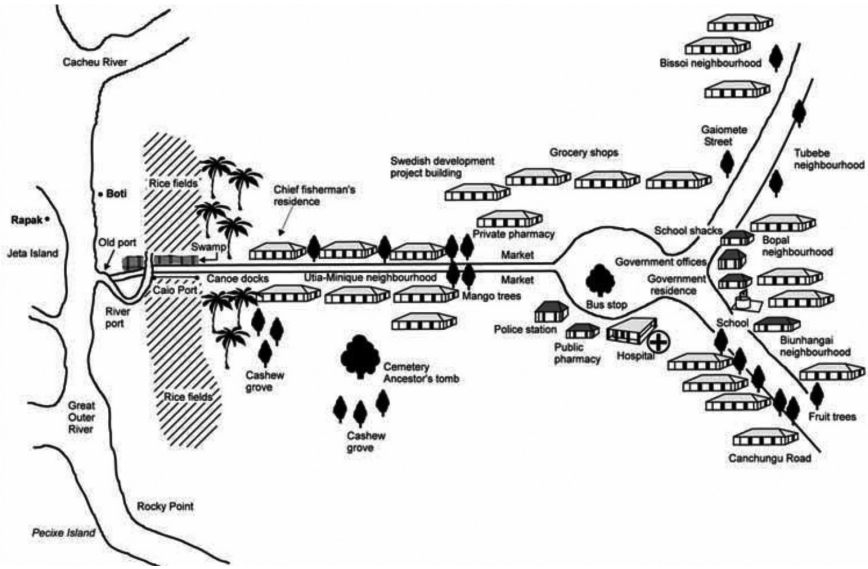


Fig.1. Village boundary map

Objectives

- To identify the boundary of the village and neighboring villages
- To learn about the structures which define physical appearance of the village

Aspects covered in the map

- Village boundaries
- Neighboring villages
- Direction
- Topographical features like hill, valley, drainage etc
- Major land forms like cultivated lands, forest
- Roads
- Major landmarks in the village

3.2 Agro-ecological map

Description: The agro-ecological map shows nature of agro-ecosystem in the village (Fig.2). It helps the researchers and villagers to identify and understand the spatial diversity of local agro-ecological resources like soil, water etc and their utilization patterns.

Fig.2. Agro ecology map

Objectives

- To learn about major agro-ecological resources in the village

Aspects covered in the map

- Location of village – boundaries and neighboring villages; roads
- Topography – Slope/elevation
- Rainfall
- Soil types – Red/ Black/Alluvial/Laterite/desert
- Land types – Upland/low land/garden land
- Depth of ground water
- Irrigation status of lands- irrigated/rainfed
- Irrigation sources - Canal, river, stream, ponds, tube well, bore well
- Drainage channels
- Bridges
- Forest
- Major crops – Season-wise
- Livestock – cattle (cow, buffalo, goat & sheep)/ pig/ hen/ duck/ fish/other water animals

3.3 Social map

Description: Social mapping involves the spatially depicting the social structure or institutions (i.e. family, houses, panchayats, village council, post office etc) and other infrastructure (electricity etc.) in a village (Fig.3).

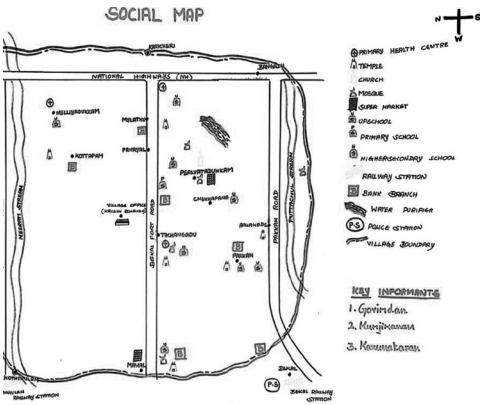


Fig.3. Social map

Objectives:

- To learn about the social structures in the village and the differences among the households by ethnicity, religion and wealth
- To learn about villagers and their way of social life
- To learn about the social institutions and villagers' opinion about these institutions.

Aspects covered in the map

- Nature and type of houses – wall (mud/ brick/concrete); Thatch (thatched/ tiled/ concrete)
- Family types – Monogamy/ polygamy (poly andry/
- Religious institutions – Temple/church/prayer hall/mosque/ gurudhwara
- Political institutions – Village council/ gram sabha/other offices
- Economic institutions – Bank/post-office/cooperatives/grocery shops/vegetable shops/small-scale industry/ pharmacy/rice mills etc
- Educational institutions – school/college/anganwadi
- Health institutions – primary health care centre/hospitals/ private clinics
- Community hall/ meeting place
- Farmers organist ions – Farmers' clubs, youth clubs, self-help groups
- Infrastructure – electricity, water supply system etc
- Social interaction – places indicate cooperation/conflict
- Leadership – formal/ informal leaders
- Social norms – places of taboo, mores
- Social issues like caste/dowry/liquor abuse/bonded labor/etc.

3.4 Resource map

Description: Resource is something that can be used for support or help in achieving livelihood objectives. The Village Resource Map is a tool that helps us to learn about the community resource base in

villagers' perspective. It is used to identify different locally available capitals/ resources and the methods with which these resources are utilized to achieve livelihood objectives (Fig .4).

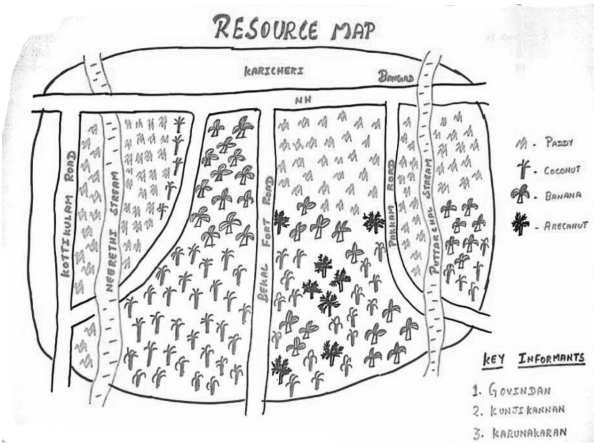


Fig.4. Resource map

Objectives

- To learn the villagers' perception of what capitals/ resources are found in the community and how they are used.

Aspects to be collected

- Capitals/ resources – availability, location, boundaries and status (abundant/scarce) access to resources are collected.

Physical capital: Tools and equipments - agricultural machinery, artisan tools, vehicle workshop, cell phone towers, generators, etc. Infrastructure - roads, electricity, water supply, market, warehousing etc

Economic capital: Crops (plantation crops, fruits, vegetables, flowers, spices etc), Livestock (Cow, Buffalo, goat, sheep, pig, poultry, duckery, fish etc.), banks, cooperatives, small scale industries, large industries, retailing units of consumer products, fruit vendors, vegetable sellers, grocery shops, hotel, other service shops etc., drinking water availability and sanitation, development programme implemented

Social capital: Farmers groups, youth clubs, community meetings, cooperation, team work

Political capital: Gram panchayat, Village Council, political party offices

Natural capital: Land types, soil – types and fertility, water resources –ponds/ rivers/ streams/canals/lakes/river/streams, rainfall, ground water status

Human capital: Educational status of villagers (illiterate/primary school/ higher secondary/ diploma/ college), availability of school, college, library, labor availability, sources of livelihoods (agriculture/ artisan/service provider/ got agencies), general health status, hospitals/primary health centers

3.5 Technology map

Description: The technology map depicts the technologies i.e. crop/ livestock/ fish/ forestry that are found in villages as well as technology adoption behavior of farmers which indicates how and why the technologies that are adopted, rejected, discontinued and reinvented. Technology map is one of the most important maps in PRA exercises necessary for preparing any research or extension programme. This gives a clue to the researcher about the type of technologies that should be developed in the technology development projects so that it will have better adoption rate (Fig. 5).

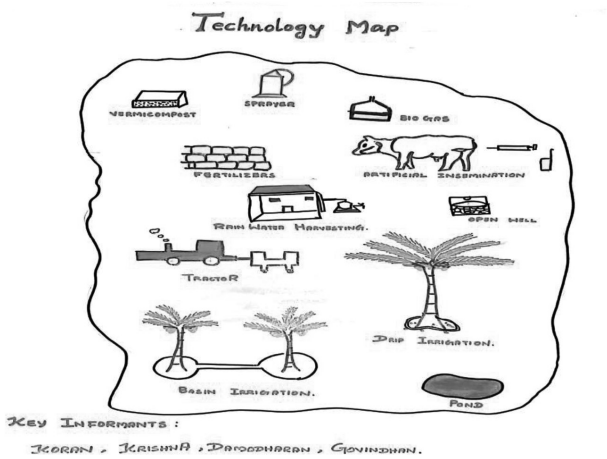


Fig. 5. Technology map

Objective

- To learn about technology adoption behavior of farmers

Aspects to be covered

This map spatially depicts the technology decision behaviour of villagers w.r.t adoption of crops, livestock, fish, forest technologies. The technology decision behaviour includes the processes of :

Adoption: Use of technology by an individual for more than once. There are two types of adoption, namely active and passive adoption.

Over adoption: Continued adoption of a technology by an individual when experts feel that he or she should have rejected it.

Discontinuance: Decision to reject a technology after having previously adopted it. There are three types of discontinuance, namely replacement, disenchantment and forced discontinuance.

Reinvention: Degree to which a technology is changed or modified by the user in the process of adoption.

Rejection: Two types, namely active and passive rejection. Active rejection consists of considering adoption of technology (including even its trial) but then deciding not to adopt it. Passive rejection refers to the decision of not considering the technology at all from the moment of its hearing.

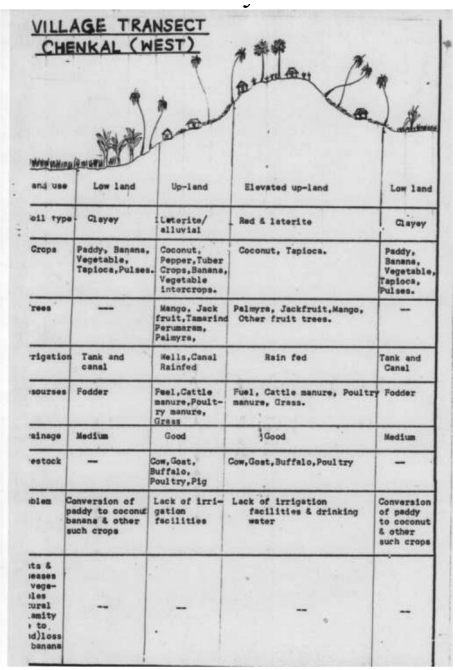
3.6 Transect walk

Description: A transect is a walk or a series of walks through an area with local informants to learn of the range of different conditions, problems and opportunities in each of the area (Fig. 6). It shows a cross section of the area as observed by the walk. The PRA team, key informants, and local extension staff take charge of this exercise. People encountered along the route should casually be interviewed to provide information on other observed conditions.

Objectives

- Verifying the information given during the community mapping exercise
- Directly observing the different resources and livelihood activities that people have referred to during the mapping exercise

- Obtaining a more detailed understanding of the resources and livelihood activities by asking probing questions about the people involved (who?), the way resources are used and activities carried out (how?), the seasonality and timing (when?) and location(where?) of resource use and the reasons behind particular patterns of use (why?)
- Identifying particular groups of households associated with particular livelihood activities and resources and noting where they live and where they can be contacted to improve one or another livelihood activity.



and use	Low land	Up-land	Elevated up-land	Low land
oil type	Clayey	Laterite/ alluvial	Red & laterite	Clayey
Crops	Paddy, Banana, Vegetable, Tapioca, Pulses.	Coconut, Pepper, Tuber Crops, Banana, Vegetable intercrops.	Coconut, Tapioca.	Paddy, Banana, Vegetable, Tapioca, Pulses.
rees	—	Mango, Jack fruit, Tamarind Perumaram, Palmyra,	Palmyra, Jackfruit, Mango, Other fruit trees.	—
rigation	Tank and canal	Wells, Canal Rainfed	Rain fed	Tank and Canal
sources	Fodder	Fuel, Cattle manure, Poultry manure, Grass	Fuel, Cattle manure, Poultry manure, Grass.	Fodder
ainage	Medium	Good	Good	Medium
estock	—	Cow, Goat, Buffalo, Poultry, Pig	Cow, Goat, Buffalo, Poultry	—
blem	Conversion of paddy to coconut banana & other such crops	Lack of irrigation facilities	Lack of irrigation facilities & drinking water	Conversion of paddy to coconut & other such crops
ts & esses vege- bles ural mity to d)less banana	—	—	—	—

Fig. 6. Village transect

Aspects to be covered

The transect should include more detailed and specific information than the maps. More specifically it contains following information.

- Topography
- Soils

- Water bodies
- Types of land use – cultivated, fallow, waste land, forest
- Cropping pattern, trees
- Livestock
- Housing pattern
- Village institutions – school, post office, gram panchayat, village council etc.
- Problems & Opportunities

3.7 Ranking and scoring

Description: Ranking simply means putting various alternatives in order of importance, value or preference. Scoring means assigning values to different alternatives, according to some convenient scale.

Purpose

Ranking methods allow us to see individual and group priorities and criteria used to select the best among a number of alternative problems or solutions. It helps to generate reasons why people choose one item from the other.

Ranking exercises are based on a comparison of various factors connected with:

Resource use: Relative importance or abundance of different resources or the benefits derived from different patterns of resource use; allocation of scarce resources to prioritized work

Livelihood activities: Type of livelihood activities (e.g. agriculture, livestock farming, service or combination) and technological options (e.g. choice crops/ improved crop varieties)

Problems faced: Identifying the problems which are most pressing or important e.g. Problems of cassava cultivation in NEH region.

Development priorities: Such as the types of constraints/ opportunities in crop/livestock production, ranked by priority, starting with those that are locally considered most important

Types

People could use three different ways to generate a criteria for comparison and make up their choices.

3.7.1 Pair-wise ranking

Pair wise ranking is used to compare between two items and make up a choice. It is more useful for exploring the reasons why people prefer one possibility over another. When a preference is made, many criteria are explored to compare items using a group of criteria before a choice. An example of pair-wise ranking of suitable crops for a particular land type is given in Table 1.

Table 1. Pair wise ranking of selection of suitable crop

	Coconut	**Arecanut**	**Rubber**	**Cashew**	**Score**	**Rank**
Coconut	X	Arecanut	Coconut	Coconut	2	2
Arecanut	X	X	Arecanut	Arecanut	3	1
Rubber	X	X	X	Rubber	1	3
Cashew	X	X	X	X	0	4

3.7.2 Matrix ranking

Direct matrix ranking is used to list items (e.g. crops/ varieties) to be compared along horizontal line and criteria (e.g. varietal attributes) on the vertical line to rank choices from most important to least important (i.e. 1st, 2nd, 3rd, 4th etc). In this case frequencies of the items valued as the first choice are counted to make up a final decision. An example of matrix ranking of suitable crops for a particular land type is given in Table 2.

Table 2. Matrix ranking for selection of suitable crops against farmers' criteria

Criteria	**Coconut**	**Arecanut**	**Rubber**	**Cashew**
High income	2	1	2	2
Long storage life	2	3	4	2
Drought resistance	1	4	3	2

Suitable for cropping/farming system	1	2	3	3
Employment for family labour	2	1	2	2
Home level processing/value addition	2	2	3	3
Rank	1	2	4	3

3.7.3 Matrix scoring

A matrix scoring helps to attach a score to comparable items (e.g. crops/varieties) against each criterion (e.g. attributes) that are listed before a choice. A comparison could be made between many items against one criteria set (e.g. high yield), and attach a score out of a maximum of 10 to items to be chosen. The frequencies of the highest scores (closer to 10) attached against many criteria helps to make up a decision for preference. An example of matrix scoring of varietal preferences of coconut is given in Table 3.

Table 3. Matrix scoring of varietal preferences of coconut

Varietal preferences for coconut		
Criteria	Local	Improved variety
High yield	XXX	XXXXX
Pest and disease resistance	XXXX	XX
Tendernut water taste	XXX	XXXX
Nutritive value	XXX	XXXX
Storage life	XXX	XXX
Market price	XX	XXXX

3.7.4 Weighted matrix scoring

The weighted matrix ranking is a tool which helps to assign importance values to criteria then technology alternatives are scored on each criterion. After obtaining the scores for each alternative, the criteria

weight is multiplied. Once the scoring of alternatives for all criteria's are completed, the sum of each alternative against all criteria is calculated. The alternative which has the highest sum of all the criteria is selected.

Steps

- Initially, the criteria for ranking/scoring the technologies are identified using discussionwith Key Informants (minimum 10).
- Then, the KI are asked to provide weightage for each criteria. (Most important – 5 marks to least important – 1 mark).
- After completion of all KI scoring, the scores of each criterion are averaged to get a mean which shows the weightage of the particular criteria.
- After identifying weightage for each criterion, a table is prepared. In the table, the criteria are placed in the rows of the table and the technologies/ varieties alternatives are placed in columns of the table. The first column of the table should indicate the weightage for each criterion.
- A total 10 Key Informants are asked score the technological alternatives against each criteria.
- A maximum of 100 stones are supplied to KI to be placed for each alternative for a particular criteria.
- After completion of the exercise, the weightage of criteria is multiplied with each alternative score in each row to obtain weighted scores. Then, the column total i.e. sum of weighted scores of all the criteria for each alternative is computed. The alternative which has the highest column total is selected as the choice.
- The choices could be between crop varieties, water points, food diets, livestock species, problems, solutions and many different issues, which require preferences.
- An example of a weighted matrix to choose a suitable crop for a particular land by the farmers is given in Table 4.

Table 4. Weighted matrix for selection of crop for cultivation

Parameters	**Factor weight**	**Coconut**	**Arecanut**	**Rubber**	**Cashew**
High yield	3.4	4	5	3	2
High income	3.8	5	6	4	3
Cropping/ farming system	3	5	4	3	1
Pest and disease resistance	2.8	4	3	2	3
Drought resistance	2.4	3	2	3	5
Value addition	2	2	1	2	1
Requirement of labour	1.8	2	3	2	2
Importance of crop	73.6	72.4	54.8	47.2	
Rank	1	2	3	4	

3.8 Time Lines

Description: Time lines provide a list of key events in the history of the community that helps identify post trends, events, problems, and achievements in its life. A historical account is given by the key informants of how different aspects of village life have changed and made impact on the social, economic and agro-ecological bases in the village. It indicates the major remembered events in the history of a village life that have direct or indirect bearing on the rural life (Table 5).

Table 5. Time Line of Maruthonkara Panchayat, Kozhikode

Time	**Events**
Before 1925s	Hindu Migration and Muslim traders in forest trees
1927-30	Migration of Christian families from South Kerala
1930	Coconut intercrop system. Introduced Rubber
1930-47	Influenced with Independence Movement
1933	First LP school

1943	First road construction
1947-57	Farmer Land Reforms Movement
1957	Land Reforms Act , Maruthonkara High school
1969	Bicycle
1970	Radio
1973	First Bus service
1975	Panchayat Board office- Maruthonkara, KVK
1976	Introduction of Improved breeds (Jersey, Swiss-HF1)
1978	Fertilizer shop
1979	Public Distribution Shop
1988	Electricity
1990	Krishi Bhavan, Truck/Jeep service
1992	Maruthonkara Service Co-operative Bank
1995	Milk Co- operative Society
1995	Landline phone, Village Administrative Office, Veterinary Hospital
1996	TV
1998	Maruthonkara Grameen bank
2000	Computer
2002	Self Help Group(SHG), Housing Scheme for STs, First artificial insemination, Introduction of Cocoa, Vanilla
2003	Bio gas, Introduction of Pineapple
2004	Inter net/Fax
2005	Mobile phone, Landslide, State Horticultural Mission(SHM), Eriophyid mite outbreak in coconut, Micro irrigation- Drip irrigation/Sprinklers irrigation
2006	Organic farming, Power Tiller, NAFED Market, Ban of Endosulfan for Ariel spray
2008	ATMA, Farmers Field School (FFS), Introduction of bush pepper, NREGA, E-Krishi, Green Love Programme in Schools
2009	Loss of cultivable land -Land slide

Objectives

- To obtain developmental historical profile of a village.
- To know the qualitative changes that have occurred over a period of time.
- To know the coping behavior of villagers during adverse years.

Aspects to be collected

- First arrival of transport (bus, car/jeep/cycle/motorcycle) and electricity
- Establishment of post office/ bank/ cooperative society/ market agency/ gram sabha/village council etc
- Year of arrival of improved crop variety (for tuber crops and others), new fertilizer, pesticide, agri. Implements, tractor, etc
- Irrigation – drip, diesel/ electrical pump
- Communication - Television, radio, cell phone, computer, laptops, digipads, etc
- Any other event which had significant impact on their livelihood

3.9 Trend Analysis

Description: It is a participatory visual method of analyzing the trends and fluctuations in the variables that influence the village life. It helps to understand the resident's perception of significant charges in the communities over time (Fig. 7).

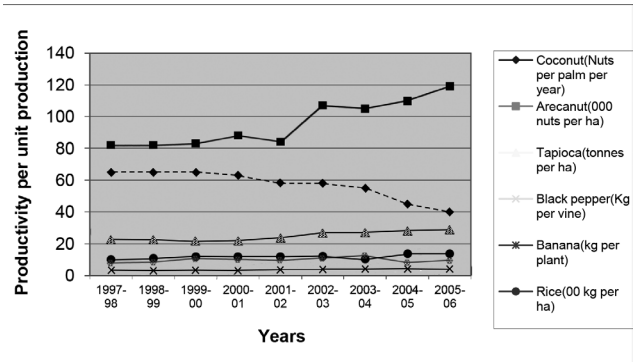


Fig. 7. Trend analysis of productivity of major crops

Objectives

- To identify the changes / fluctuations in some aspects/ variables that have occurred over a period of time that has significant influence on their livelihoods.
- To explore the coping behavior of villagers during adversities.

Aspects to be collected

- Area and production of plantation crops
- Major pest/ disease incidence (if any)
- Market price
- Demand and Supply

3.10 Seasonal calendar

Description: Seasonal calendar attempts to establish regular cycles or patterns of activities and occurrences within a community over 12 months. It can be used for purposes such as rainfall distribution, food availability, agricultural production, income and expenditures, health problems, and others (Fig. 8).

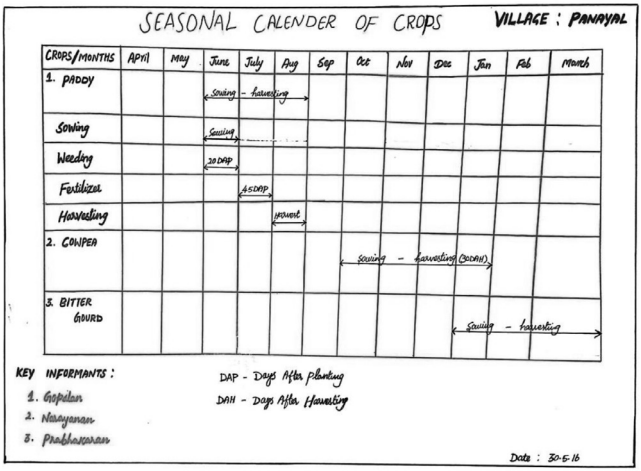


Fig. 8. Seasonal calendar

Objectives

During the community profile, seasonal calendars will be used primarily to:

- Represent and analyze, together with respondents, the seasonal patterns of the main livelihood activities in the community
- Represent and analyze the seasonal patterns of resource use
- Identify patterns of vulnerability due to seasonal factors, which is affected by those patterns and what their responses and strategies are to deal with them.

Aspects to be collected

- Agricultural seasons
- Major crops and livestock
- Rainfall
- Labor availability
- Source of irrigation
- Shortage of drinking/ irrigation water
- Major pest and diseases
- Market price
- Agricultural credit availability
- Distribution of work – agriculture/ labor
- Labor migration
- Food shortage
- Shortage of animal feed
- Human and animal diseases
- Sources of income
- Expenditure

3.11 Venn Diagram

Description: Venn diagram shows institutions, organizations, groups and important individuals found in the village as well as the villagers view of their importance in the community. Additionally it explains who participates in these groups in terms of gender and wealth. Venn diagramme also indicates how close the contact and cooperation between those organizations and groups is depicted in Fig. 9.

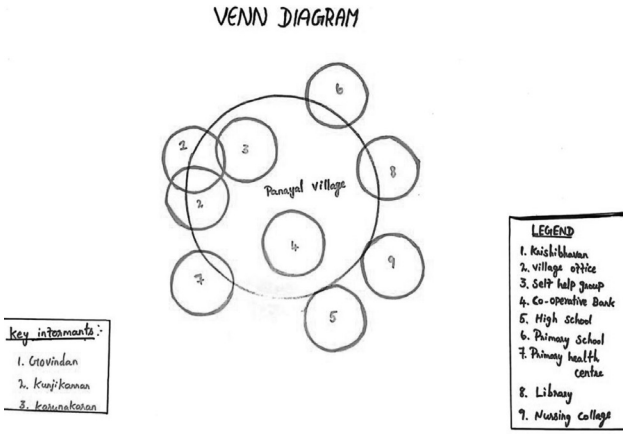


Fig. 9. Venn diagram

Objectives

- To identify external and internal organizations/groups/important persons active in the community
- To identify who participates in local organizations/institutions
- To find out how the different organizations and groups relate to each other in terms of contact, co-operation, and flow of information and provision of services

Aspects to be collected

Institutions and their importance for

(i) Production and utilization of plantation crops and (ii) Institutions – credit agencies, research institutes, KVKs, University, marketing agency, cooperative bank, village council, gram panchayat, state Agri/ Horti department, etc.

Key Questions

- Which organizations/institutions/groups are working in or with the community?
- Which institutions/groups do the villagers regard as most important, and why?
- Which organizations work together?
- Are there groups, which are meant for women or men only?

- Are some particular groups or kind of people excluded from being members of or receiving services from certain institutions?

3.12 Problem Identification Technique

The problem identification technique is used to identify and prioritize the problems prevailing in agricultural sector in the village. For this purpose, a group of farmers are identified from the village representing all sections of the village will be selected using snowball technique. Once the problems are identified, they can be prioritized through Rank-Based Quotient (RBQ) analysis. The RBQ value can be arrived through the following formula (Shenoy *et al.*, 2006)

Rank Based Quotient

$$\text{RBQ} = \sum_{i=1}^{n} \frac{\text{f i (n + 1 − i)}}{\text{Nxn}} X100$$

Where,

i = Concerned ranks (1 to 4)

N = Total numbers of farmers (30)

n = Total number of ranks (4)

f = Frequency (No. of farmers reporting that particular problem under ith rank)

Identification of problems in agriculture using RBQ is depicted in Fig. 10.

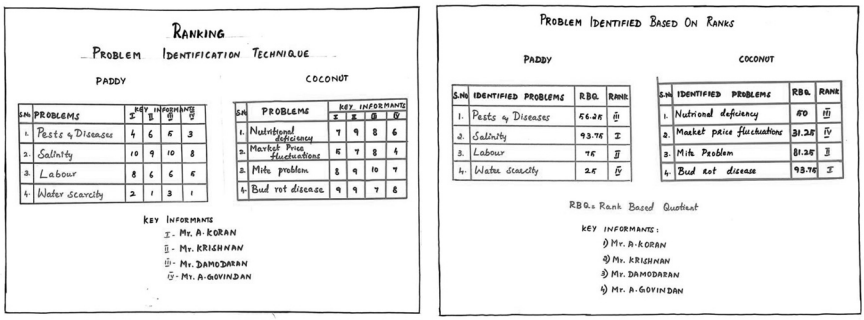


Fig. 10. Problem identification using RBQ

Conclusion

PRA techniques are the methods to assess the agricultural and rural situation and prepare appropriate action plans based on the active participation of target clientele groups. These techniques are time tested and the usefulness of PRA techniques are already being implemented by many developmental organizations and non-governmental agencies for preparation of need-based action plans. Under the circumstances of democratic decentralization and inclusive agricultural and rural development, the role of PRA methodologies is indispensable. PRA methodologies ensure active participation of target audience and bring-out their felt needs. Hence, it may be concluded that the PRA techniques are recommended for identification problems of plantation crops and develop appropriate action plans.

References

Barham, J. and Diamond, A. (2012). Moving food along the value chain: innovations in regional food distribution. Washington, USA: U.S. Department of Agriculture. Agricultural Marketing Services.

Chambers, R. (1989). Editorial introduction: vulnerability, coping and policy. IDS Bulletin. 2(2):1-7.

Food and Agricultural Organization (1996). Food security. FAO Policy Brief Issue 2. Rome, Food and Agricultural Organization.

Frankenberger, T.R. and McCaston, M.K. (1998). The household livelihood security concept. PRA tools to your needs. An example from a participatory household food security Food, Nutrition and Agriculture, 22, pp. 30-35.

Pokharel, R. K. 1998. Community and participatory forestry development in the Tarai, Nepal submitted to IOF/ITTO project, Nepal.

Scoons, I. (1998). Sustainable rural livelihoods: a framework for analysis. IDS Working Paper 72, Brighton, UK: Institute of Development Studies.

Shenoy, Sandhya N., Rama, Rao D., Rao, N H., Reddy, M N. and Sontakki, B S. 2006. ICTs for sharing agricultural information in rural India, AP Cess Project Report, National Academy of

Agricultural Research Management (NAARM), Hyderabad, P 1-20.

Sontheimer, S., Callens, K., and Seiffert, B. (1999). Conducting PRA training and modifying and nutrition project in Ethiopia. Rome: Italy: Food and Agricultural Organization.

Sivakumar, P.S., Anantharaman, M., Roy, A., and Seeralan, S. (2012). Sustainable livelihood assessment and value chain analysis: Tools and techniques. Training handbook. CTCRI-NEH Training series -1, Central Tuber Crops Research Institute. Thiruvananthapuram, Kerala

Innovative extension approaches for plantation crops (2016) : 97-103
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Participatory technology assessment and refinement for plantation crops

Sreenath Dixit and Sairam, C.V.

Introduction

Small holders' plantation crops like coconut, arecanut, cashew, cocoa etc. play a major role in the agrarian economy of southern states like Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, and Goa and UTs like Puducherry and Lakshadweep. These crops provide income and employment to several millions of smallholder families. The special characteristic features of these crops include long period of gestation, multiple phases of growth and relatively less risky compared to field crops. However, decisions on choice of crops cannot be revoked easily.

National Agricultural Research System (NARS) continuously strives for achieving sustainable growth in plantation crops sector by evolving appropriate technologies to address various problems. However, the plantation sector in India faces several challenges in the form of monsoon vagaries, degrading soil, fast depleting surface and ground water resources, increasing input cost and cost of hired labour, fluctuating market prices etc. Under these situations, for achieving sustainable growth in this sector, technically feasible and economically viable technologies need to be promoted on a larger scale after proper assessment and refinement of those technologies on a participatory mode involving farmers, scientists and development personnel. Scope for Participatory Technology Assessment and Refinement with respect to Plantation Crops is discussed here.

Concept of Technology Assessment and Refinement

Research conducted under controlled conditions often need fine tuning

before their adoption by farmers. With the objective of developing location specific technology modules, Krishi Vigyan Kendras, the frontline extension wing of National Agricultural Research System, has the primary mandate of technology assessment and refinement. The entire process is done on participatory mode involving all the clients. The process of Technology Assessment and Refinement (TAR) is done through the tool known as On Farm Trial (OFT).

Technology Assessment and Refinement refers to the process or a set of activities before taking up new scientific information for its dissemination in a new production system. TAR is a process or the activities, which relate research with dissemination (Field Extension). Often the situations under which the scientific information generated are unlikely to be same from those operated by the farmers. This scientific information is to be reviewed in terms of specific needs, opportunities and constraints faced by the farmers in different production systems.

Technology Assessment and Refinement is a process, which acts as an intermediate stage between Technology generation (Research System) and Technology dissemination and their adoption (Extension System). There are three major stages of TAR viz., i) Technology Testing, ii) Technology Adaptation and iii) Technology Integration.

Small farm production system are complex, diverse and risk prone systems and the same has certain characteristic features viz., strong relationship between land and household economy, inter-linking between and on and off farm employment, predominance use of household inputs, prevalence of traditional practices, operation of multiple enterprises mainly on subsistence basis, more dependence on family labour etc.

Technologies evolved through National Agricultural Research System mostly under controlled conditions are being accepted at a lower level by the farmers mainly for the reasons that they are not operationally feasible, economically non-viable, not stable, often not matching with the farmers need and not compatible with the overall production systems.

On Farm Trial refers to the exact trials in the testing the technologies

under farmer's field conditions with their participation and involvement. The major steps in TAR include i) problem identification, ii) problem prioritization, iii) finding various technology options through discussions iv) designing OFTs, v) implementation of OFTs and vi) follow up and getting feedback from clients. Once a particular technology option is found to be technically feasible, socially acceptable, economically viable and environmentally safe in a particular location specific environment, then the same can be popularized among the farming community through Front Line Demonstrations. If not, the best performing technology option may be modified a little for suiting to the local conditions through technology refinement and then popularized through Frontline Demonstrations.

The technology development, testing and utilization continuum depicted above provides a clearer view of the larger role for assessment in between the two ends of technology chain.

Technology assessment must consider the four important properties of a production system viz., productivity; profitability, stability, sustainability, equitability etc. Productivity and profitability are considered by most researchers, as they have well defined parameters and measurement procedures. However, the stability and sustainability dimensions are rarely assessed, partly because the parameters are not well defined and partly because researchers do not attach much importance.

Productivity: It is the net increment in valued product per unit of resource (viz., land, labour, energy or capital). It is commonly measured as annual yield or net income per hectare or man hour or unit of energy of investment.

Profitability: The realized net return per unit area need to be positive and only those technologies, which are highly profitable will be preferred and adopted by the farmers on a sustainable basis.

Stability: It is the degree to which productivity remains constant in spite of normal, small scale fluctuations in environmental variables, such as climate, or in the economic conditions of market.

Sustainability: It is defined as the ability of a system to maintain its productivity when subject to stress or perturbation. A stress is

here defined as a regular, sometimes continuous, relatively small and predictable disturbance, for example the effect of growing soil salinity or indebtedness. A perturbation, by contrast, is an irregular, infrequent, relatively large and unpredictable disturbance, such as is caused by a rare drought or flood or a new pest.

Equitability: Is a measure of how evenly the productivity of the agro-eco-system is distributed among the human beneficiaries? The more equitable the system, the more evenly are the agricultural products, the flood or the income or the resources, shared among the population of the farm, village, region or nation.

Steps in Technology Assessment and Refinement

There are five major steps in Technology Assessment/Refinement viz., Diagnosis, Planning (setting priorities), conducting On Farm Trial, Assessment/Refinement,Extrapolation/ Extension.

Diagnosis: It is the process of understanding the components of farming system and system interactions and to identify the problems limiting the productivity of the resources available to farmers and understand the causes of those problems.

Planning: Planning process primarily aims for priority setting. During this stage, problems of a particular farming system are identified along with their causes and solutions for these problems are found out. The major steps in planning process include listing and ranking of problems, identification of causes for priority problems, finalization of problem-cause diagram, finalization of all possible solutions to well defined problems and screening of possible feasible solutions. Problem identification can be done through direct observations in farmer's fields, Participatory Rural Appraisal Techniques and formal surveys, yield cut surveys, exploratory trials, previous studies, weather and/ or soil data, long term monitoring of farmer's fields and long term trials. Some of the examples include uneven plant stand, insect damage, moisture stress during longer dry spells, nutrient deficiencies, weed competition etc. Once the problems have been identified for different farming systems, they need to be prioritized based on their endemic nature, intensity of spread, extent of damage likely to be caused, availability

of scientific solutions etc. Then for the prioritized problems, Problem-Cause Diagram needs to be formulated and based on that various factors influencing a particular problem can be understood and suitable scientific solutions can be identified for addressable issues.

The final steps being conducting the On Farm Trial is done scientifically involving farmers, scientists of NARS and extension personnel and scientific data pertaining to the problem identified are collected from various technology options proposed for conducting the OFT. Once the trial is completed the results are triangulated and analyzed in various angles and then recommended for dissemination for a larger scale involving field extension machineries.

Major thematic areas of technology assessment and refinement

Improved varieties: Assessing the performance of varieties for different micro-situations has been a major area of technology assessment. New varieties in coconut like Kalpatharu, Kalpa Jyothi, Kalpa Surya and Kalpa Haritha can be tested under coastal, midland and uplands situations comparing with other varieties like West Coast Tall, COD x WCT, WCT x COD etc. In case of coconut those varieties which are early bearing in nature, yield consistently high in the mid bearing phase, tolerant to major pests and diseases and fetches better market price are always preferred.

Soil management: Measures to protect and enhance the productivity of soil include adequate application of cow dung or Farm Yard Manure, soil conservation, cover-cropping, green manuring, and maintaining soil cover with plants and/or mulches.

Water management: Water requirement for plantation crops is more and under agro-climatic conditions like North Kerala, wherein, six months of continuous dry spells are there, providing irrigation to plantation crops like coconut, arecanut, cocoa etc has become a serious challenge. Assessment on fertigation under various soil and topography conditions is some of the challenging areas where participatory technology assessment could play a major role.

Perennial crop based cropping/farming systems: Plantation crops grown with wider spacing, always provide scope for cultivation of inter/mixed crops and could provide avenue for integrating other enterprises like dairy, poultry, rabbitry, piggery, fisheries etc. Technology assessment could be undertaken on various models suitable for different land holding sizes considering the available local resources and market preferences.

Integrated pest and disease management: Plantation crops are prone for various pests and diseases and several chemicals are being used for management of various pests and diseases. Under the forthcoming scenario in which Kerala State has been declared as an Organic State since 2016, eco-friendly pesticides and plant based insecticides need to be assessed and recommended for the farmers

Farm mechanization and maximizing labour-use efficiency: Selective farm machineries and equipment like coconut climber, arecanut sprayer, weeder etc can be tested for their suitability in the plantations

Conclusion

National Agricultural Research System has evolved many technologies under various thematic areas for addressing the major issues and for sustainable growth and development of plantation sector in the country. In order to increase the adoption level of these technologies, they need to be assessed for their technical feasibility and economic viability on a participatory mode involving farmers, scientists and development personnel and then disseminated on a larger scale.

References

Das, P. and Prabhu Kumar, S. (eds.). 2008. "Models of technology delivery Mechanism – Experiences of KVKs", Technical Compilation by S. K. Das, N. Sudhakar, M. J. Chandre Gowda, C. V. Sairam, K. Mahadeva Reddy, N. Anandaraja, K. Ramakrishnan and S. Suresh, Division of Agricultural Extension, ICAR New Delhi.

Sreenath Dixit and V. I. Benagi. 2016. "Technology Delivery Mechanisms

of KVKs for higher productivity and profitability in agriculture, (Eds.), P. S. Hugar, C. V. Sairam, M. J. Chandre Gowda, D. V. Srinivasa Reddy, B. T. Rayudu, D. V. Kolekar and Mallikarjun B Hanji, Compilation of Abstracts for the First KVK Symposium held at UAS Dharwad during 21-22nd January 2016.

A. K. Mehta, V. Venkatasubramanian, Ashok Kumar Singh, Ajoy Kumar Singh, N. Sudhakar, C.V. Sairam, Moolchand Singh, D.V. Srinivasa Reddy, R. S. Ramamurthy and Mallikarjun B.Hanji, (eds.). 2009. "Case studies on transformation of district agriculture–experiences of KVKs" Chief editors: Kokate, K.D and Prabhu Kumar, S. Prabhu Kumar S, Reddy, D.V.S., Sairam, C.V. 2009. In: "Drought Mitigating Interventions of Krishi Vigyan Kendras", (Eds.), Kokate, K.D., Singh, A.K., Singh, Lakhan Singh.

Innovative extension approaches for plantation crops (2016) : 104-115
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Participatory community extension approaches for technology refinement and utilization – Case of area wide management of coconut pests

Anithakumari, P.

Introduction

Coconut communities face several constraints which need to be addressed through research innovations. The challenges of agricultural extension varies with community, localities, crops, contexts, mode of communication etc and it has to undergo changes with time for improving efficiency and relevance. ICAR- CPCRI deals with research on mandate crops such as coconut, arecanut and cocoa as well as the cropping/ farming systems. Coconut is one of the important palm crops being cultivated 18 states and 3 Union Territories of India and one of the most versatile and environmentally benign crop, providing food, beverage, fuel, wood and bio energy. Out of 5 million coconut holdings in the country, 98 % are below 2 ha in size and 3.5 million holdings are in Kerala state. This poses challenges for the research, extension, development sectors in terms of appropriateness, scaling up, economic utilization of resources and marketable surplus in production. Infestation of pests and diseases is the most cited production constraint of the crop. But in several studies the adoption of plant protection technologies was reported to be very low; below 5%.

Alternative extension mechanisms for managing field problems of coconut needs special emphasis, while considering the following factors.

- Coconut a perennial plantation crop, cultivated in contiguous area in small and marginal land holdings (average holding size of 0.2

ha) provides congenial conditions for pest and disease incidences throughout the year is a challenge for technology delivery among farming community with varied resource base, socio personal and psychological variables.

- Need for specific social process and approaches for transformation in technology awareness, dissemination and utilization. The approaches and strategies differ not only with social factors but also with technology characters per se.
- Nature of the crop, nature of pests/ disease causing organisms, incidence, severity and potential spread of pests or diseases as well as the observable nature of loss incurred influences the extension mechanisms/ approaches required.
- Constraints such as input availability, technical/extension/ economic factors, social components, economic factors and bio physical constraints requires attention for evolving extension approaches or mechanisms.
- Extension approaches/mechanisms needs paradigm shift from individual farmers to area wide or groups/community based for improving efficiency. Time, cost, impact, economic/environment benefits and resource efficiency could be achieved through linkages, appropriate technology choices, participatory approaches and implementation.

Components of area wide community extension approach (AWCA)

The coverage and efficiency of the extension set up (Krishibhavans at Panchayath level with one agricultural officer and 2-3 agricultural assistants) in reaching out to farming community may be lower to expectations, due to multifunctional responsibilities. The initial efforts on extension approaches for improving adoption of Green Muscardine Fungus (GMF) among coconut farmers started in 2007 in two panchayaths of Alappuzha district with poor field responses. Hence in 2008 initiated Farm Level Production (FLP) unit with a qualified person, but it did not sustain and an area wide campaign for treatment of breeding sites of rhinoceros beetle in 1500 ha was taken up, which

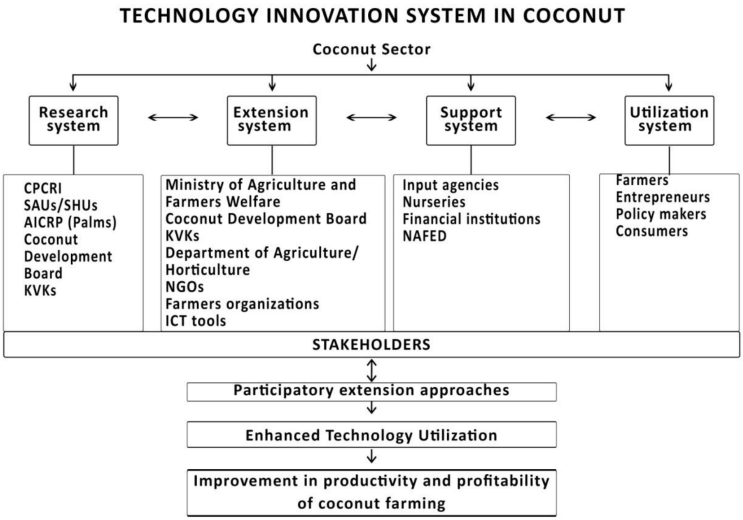
proved to be time consuming/less efficient. Inadequate availability of bio agent and inability to achieve full coverage were the problems experienced. ICAR-CPCRI took up a pilot effort in Edava panchayath during 2010-2013 and evolved a tested extension approach which was scaled up in several districts subsequently.

The learning experience asserted that technology package supported with appropriate extension mechanisms based on socio-economic situations and technical parameters, results in wide spread awareness, adoption and demand for technology. The model community extension approach evolved in the study also 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 was the decentralized option for technology facilitation viz., capacity building of women farmer groups as master trainers and farm level producers of Green Muscardine Fungus (GMF) and targeting the 'potential and critical adopters' of the bio control technology. The non adoption of the technology by the 'potential or critical adopters' could render the community level adoption of the technology by other coconut farmers ineffective. Another lesson learned was integration of indigenous technical knowledge (ITK) like incorporation of Clerodendron plants in breeding sites, leaf axil filling with salt/sand/ash mixture with recommended technologies.

The scattered breeding sites of rhinoceros beetle in the panchayath like livestock farmers (643 nos.), vermicompost units (7nos.), coir pith heaps (3 nos.) were mapped in panchayath indicative of the locations in each ward and it was found that 82 per cent of these potential / critical adopters were distributed in 6 wards. They were reached through coordinated efforts of peoples representatives, extension units of Department of Agriculture and Animal husbandry, milk cooperative societies in which 85 per cent of livestock farmers are members and women Self help Groups (SHGs). Through this approach more than 90 per cent of the potential adopters were reached within 2 months and post intervention data indicated 75.8% reduction of fresh pest infestation. The farmers revealed that grubs were infected by fungus

after a week of treatment and infected grubs could be collected from all wards indicative of reduction of pest population.

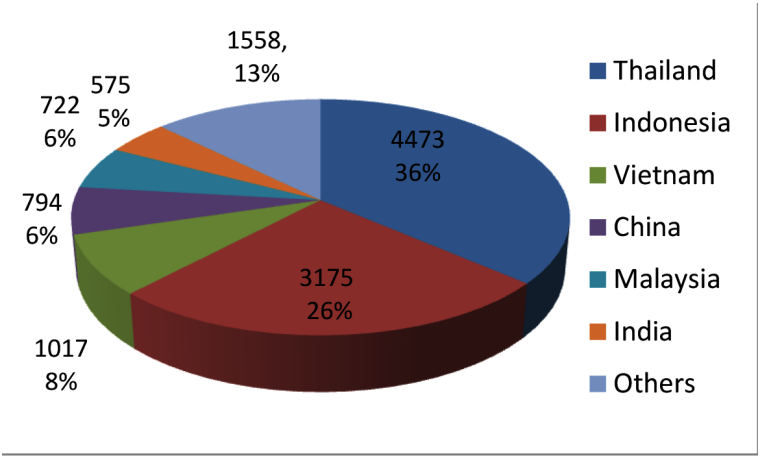
Community Extension Approach (AWCA) of Bio-management of Rhinoceros beetle



The extension interventions included simple extension literature in local language, field visits, small group meetings, off campus training programmes (32 nos), video conference with experts for midway corrections and feedback (7 nos) and low cost farm level GMF multiplication unit by women group for decentralized sustainable bio input availability. The continuous supply of GMF was ensured through supply of mother culture from CPCRI for every batch and total of 6000 packets were distributed in the project area and other districts on demand. Federated women farmers (Edava Womens' Association – EWA) served as technology promoters and master trainers in FLP of GMF, integrated farm level value addition of coconut, jack, vegetables, tubers and cow dung, mushroom cultivation/ spawn production and processing, vermicomposting. Rural training centre was started wherein 2054 farmers from different districts were trained for knowledge and skill transfer.

Impact on Knowledge improvement

Knowledge on the pest, symptoms, potential damages and management practices is important in participation and technology utilization. It was noted that knowledge of coconut farmers was higher in intervention area (i.e. Edava grama panchayath, Trivandrum district) compared to non-intervention area (control farmers) (Kotamkara grama panchayath, Kollam district).



Reduction in knowledge gap by 10-40 percent among coconut farmers of Area Wide Community Approach area compared to non-intervention area could be achieved.

Impact of the Community Extension components

Sl. No	Variables	Before interventions	After interventions	χ2#
1	Social participation	1.18	1.89	0.164
2	Extension contact	1.62	8.13	4.35*
3	Extension participation	0.20	4.37	4.51*

4	Mass media exposure	3.22	3.55	0.042
5	Trainings attended	0.08	0.23	3.99*
6	Research linkage	4.026	19.75	4.53*
7	Extension linkage	17.80	28.04	3.88*

#Mc Nemars test of significance value

The impact of AWCA recorded that social participation, extension contact, extension participation, mass media exposure and trainings attended, research and extension linkages significantly improved when compared before and after interventions, indicating positive impact of the extension approach. The improvement in awareness among extension officials acquires importance since this could positively influence up scaling of the technology and extension approach.

Prior to the project implementation, the percentage incidence of rhinoceros beetles was ranging from 50.56 to 91.89, whereas in the post – project period the infestation varied with a lesser range (between 39.29 and 77.42 percent). Percentage reduction of infestation varied between 4.17 to 34.38. In seven wards, percentage reduction of infestation was more than 25.

The overall percentage infestation in the pre – project implementation period was estimated to be 72.88 ± 9.29 and it was significantly decreased to 58.08 ± 9.27 in the post- project period. In terms of number of infested palms in the panchayath a reduction of 20.3 percent was thus noticed as a result of AWCA.

Reduction in Rhinoceros beetle infestation after AWCA

The data also showed that AWCA could result in reduction of pest incidence in a continuous geographical area indicating the effectiveness in spite of varied field/ farmer conditions. The lessons learned from this participatory action research were that the stakeholders in each sub locality may not be same in terms of number, leadership,

institutionalisation, vision and mission. Hence, for realizing area - wide response and impact of social interventions, these factors are to be mapped and considered for planning and implementation. Hence this experience teaches the need for adopting refined strategies in locations with specific situations keeping the basic principles of the approach.

Reduction in severity of rhinoceros beetle incidence due to AWCA

AWCA of bio management practices is effective in a contiguous geographical area compared to varied adoption and impact of technologies among individual farmers' plots. The major gains recorded by the participated farmers were low cost, less drudgery and environment/ farmer friendliness. The area wide approach further strengthened its utility in reduction of efficacy of the technologies across the system of intervention compared to the household or individual level technology adoption. The extension approach facilitated to overcome the major challenges of fragmented holding of coconut cultivation in terms of its perennial nature, effective and purposeful linking of stakeholders, targeting critical adopters to improve reachability to large area with lesser time. When compared to individual level adoption farmers opined 70-80 percent reduction in cost of technology adoption.

The reduction of pest incidence in terms of average number of typical v-shaped cut symptoms was highest among adult bearing palms compared to non-bearing juvenile palms. But reduction in pest incidence was recorded in both categories in intervention area (compared to increase in pest incidence in adult bearing and non-bearing palms in the non-intervened area) indicated clearly the relative advantage of area-wide community level technology adoption. The comparative higher level of pest incidence in seedlings of intervention area calls for further studies and analysis considering that they are more prone to attack. It also warrants systematic adoption of prophylactic measures in seedlings while going for area - wide community approach.

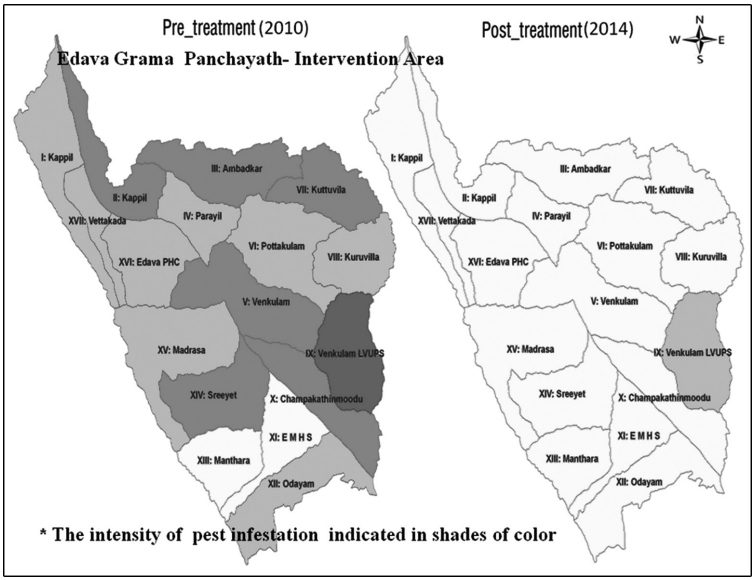
Community feedback for field level refinement in technology adoption

The Technology of GMF- FLP was refined by the group reducing 40

per cent costs and 30 per cent time. The participating farmers gave feedback that frequency of breeding sites treatment should be once in a year for better results instead of two years as recommended based on their observation and experience of adopting the technology which was approved by the experts on further examination. They noticed that the fungus was not surviving or infecting grubs during the summer months when the cowdung was removed for seasonal intercrops, leaving only a portion of treated organics as recommended, and needs replenishment every year. Thus AWCA proved to be not a passive process but involved interactions among and between stakeholders improving technology demand and utilization.

The most remarkable outcome was the improvement in technology access and social role of rural women farmers in dissemination due to community extension approach along with empowered participants. An up-scalable participatory model for area - wide community adoption was put forward and replicated in 6000 ha of coconut area achieving reduction in rhinoceros beetle incidence.

Impact of AWCA in the geographical area of the Edava panchayath (Intervention area)



Area wide Community extension for Red Palm weevil management

Collective actions involving farmers and non- farmers, diverse participants are needed for solving community based problems, successfully. This is specifically applicable in case of Red palm Weevil menace in coconut leading the complete loss of palms due to this pest infestation. Collective action is defined as 'a set of actions taken by a group of farmers, often in conjunction with other people and organisations, acting together in order to tackle local agri-environmental issues' (OECD 2013).

The specific factors to be taken into consideration for evolving extension approaches for area wide management of red palm weevil were as follows:

- Very low level of knowledge, adoption on the pest and management practices and skills for early identification of pest incidence
- Complete loss of infested palm send alarm feelings among farmers.
- Low availability of coconut climbers and high cost of plant protection measures. Timely plant protection is critical in saving a palm infested by red palm weevil and this could not be done due to social factors
- Spread of the pest is sensed by the coconut farmers community, but extension interventions spanning the community is lacking at present. This requires collective actions which require specific management skills.
- Plant protection recommendations also consider individual palm basis, hitherto leading to inefficient results when area wide potential for spread exists.
- Lack of exposure and trainings to extension officials in collective area wide extension management aspects. Moreover, policy support also needed for projects and programmes leading to collective impact.
- The extension components included:Documentation of village/ panchayath level resources, social technical economic variables, stakeholder analysis, crop and farmer profiles, GIS mapping- initial

steps for defining potentials and problems to be addressed

- Unit of interventions or technology adoption changed to community wise spanning area wide continuity up to 1000-2000 hectares
- Evolving and equipping 'Master trainers' in red palm weevil management and other plant protection aspects of coconut
- Ensuring participation and involvement of multi stakeholders groups or farmer clusters like women farmers groups, crop based farmers groups, progressive farmers, agricultural extension officials, veterinary department, milk farmers societies, coconut producers societies and federations, peoples representatives and local self governments. The social resources could be mobilised and converged through this process.
- Utilizing multiple locality based channels and modes.
- Participatory prioritisation of field problems- Eg., spread of Red palm weevil infestation and increasing loss of coconut palms, increasing incidence of associated pest (Rhinoceros beetle) and disease (leaf rot), shortage of coconut climbers, lack of community mechanisms for timely scientific plant protection of coconut palms and low level of technology awareness.
- Location specific planned interventions supported by stakeholders and expert facilitation of ICAR-CPCRI scientists
- Training programmes, Integrated coconut Field Clinics (ICFC), Coconut plant protection and surveillance groups (CPPSG) formed part of the social mechanisms evolved.

Technology Delivery Models: Area wide community extension approach for management of coconut red palm weevil, the fatal pest of the palm, was pilot tested in Bharanikkavu Grama Panchayath, Alappuzha district in 2000 ha during 2014 and 2015, involving 7068 farm families with 1,74,733 coconut palms at various growth stages. The GPS plotting of the palms infested by red palm weevil (dead and alive) was recorded during the pre-and-post intervention periods. The innovative components evolved were, formation of 12 coconut plant protection and surveillance groups (CPPSG) in all wards comprising of 2-3 members of women self help groups/representative of coconut farmer

organization/volunteers from the ward. Follow-up interventions of appraisal and corrective measures were adopted through organization of 19 Integrated Coconut Field Clinics (ICFC), mobilized in participatory mode for further identification and management. An exclusive mobile number was dedicated and given publicity for farmers to report on red palm weevil incidence in their palms at any time. An SMS service was also started for exchange of information among the farmer leaders and field facilitators. Eighteen master trainers were capacitated for farmer-to-farmer technology transfer and first level field diagnosis and linkage with research or extension system. The spread of the pest in farmer fields was aggregate in nature as depicted by index of patchiness. The spatial distribution of red palm weevil incidence in farmer plots of 21 wards reduced from 2.93 per cent to 0.38 per cent due to the interventions, an 87% reduction in fresh incidence. About 30-40 per cent of affected palms could be saved through pesticide application. The area-wide community extension approach for red palm weevil management is effective and up-scalable. The potential sources of pest inoculum are still present in the project area, but were managed by individual farmers. Farmers recorded their constraints and perceptions in management of red palm weevil of coconut, in the order of ranking as "high labour charges for plant protection of coconut", "climate change", "Lack of/low level of knowledge on chemicals to be used for controlling the pest", "infestation of the pest in palms could only be noticed after death of the palms", and "lack of early identification tools or methods".

Conclusion

Area wide community extension approach for management of coconut red palm weevil was successfully implemented by adopting participatory principles. Participatory approaches resulted in additional benefits for society in the areas of environmental conservation, sustainable management of natural resources and protection of human health. Unlike the conventional extension approach, benefits are not all associated with adoption of specific technical recommendations. This is especially important when it comes to complex concepts like integrated pest management, for which farmers use their newly

acquired skills in response to random events, such as pest infestation, and make appropriate decisions based on their own knowledge. The same holds true for other areas, such as adaptation to changing markets and the policy environment. Therefore, impacts of the participatory extension approach should not be measured only by an increase in short-term income. Realization of full benefits depends on future events. A proxy measure for these benefits may be the cost savings realized by eliminating the need for constant re-training and implementing new projects in relation to new technology.

References

Anithakumari, P., K. Muralidharan and Chandrika Mohan. 2016. Impact of area-wide extension approach for bio-management of rhinoceros beetle with Metarhizium anisopliae. Journal of Plantation Crops 44(1): 16-22

Anithakumari.P., K. Muralidharan. and S. Kalavathy. 2015. Community extension approach in biomanagement of rhinoceros beetle the major pest of coconut. Indian Research Journal of extension education 15 (1): 70-75.

Krishna kumar, V., Merin Babu, Reji Jacob Thomas, Joseph Rajkumar, Anitha kumari, P, Vinayaka Hegde, P. Chowdappa. 2015. Root wilt disease of coconut: bench to bunch strategies. Technical bulletin-91.Centenary publication-2. p.27

Anithakumari. P, K. Muralidharan, Chandrika Mohan, V. and P. Chowdappa. 2016. Community based extension mechanisms for pest and disease management of coconut- Success stories. Technical bulletin No. 98. Centenary publication 18. P. 28

Innovative extension approaches for plantation crops (2016) : 116-124
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Streamlining community based organizations for climate smart agriculture

Kalavathi, S.

Introduction

India being a tropical country with increasing dependence on natural resources, the chances of experiencing impact of climate change will be more. The Food and Agriculture Organization (FAO) expects that considerable efforts would be required for developing countries to deal with climate-related impacts, particularly in agriculture (FAO 2007). At the country level, climate change refers to observable changes and permutations of temperature, rainfall and extreme climate events and their single or collective impacts on various agricultural production and harvesting activities (Concepcion, 2008). Compared to increase in temperature, climate disruption in terms of changes in variability in rainfall will be more difficult to react and adapt (FAO, 2012). Ray *et al.*, (2014) reported that most of the coastal areas suffer from excess water in monsoon season with a problem of prolonged deep water submergence having adverse effect on crop growth. In coastal states like Kerala having long coastal line, the problems of water logging and salinity are critical factors affecting agricultural productivity.

According to IPCC (2007), reduction of crop yields due to crop damage and crop failure, water logging of soils due to increased rainfall and flooding, increased livestock disease and mortality, and salinization of irrigation water can be expected to affect the activities and productivity of smallholder farms. To reduce vulnerabilities due to climate change, Climate Smart Agriculture (CSA) involving identification of barriers to adoption and providing appropriate solutions (FAO, 2013) has to be

adopted. Increasing diversity of production at farm and landscape level is an important way to improve the resilience of agricultural systems (FAO, 2010). For effectively streamlining such activities at grass root level, initial efforts can better be made for assessment and refinement of the technologies in a small scale, where local adaptations can be identified and standardized through farmer participation. Once the practices are standardized for their suitability to a particular location and also for the adaptability to climatic vagaries, it can be replicated at a regional level.

An attempt at a smaller scale was attempted with farmer participation by ICAR-Central Plantation Crops Research Institute, Kayamkulam in two FLD gardens in the southern coastal tracts at Arattupuzha (Alappuzha) and Alappad (Kollam), where poor fertility status of the soil due to poor physical and chemical constraints of soil, water logging due to precipitation variation and salt water inundation were observed as major impediments to successful cultivation of coconut and year-round cultivation of many of the intercrops.

Methodology for technology assessment and refinement for standardization of climate-smart adaptations

Technology demonstration was undertaken in 1 ha each in both the places in a participatory mode with timely assessment of the practices and suitable refinements for climate resilience. The steps followed include:

- Introducing recommended technology package to the farmers.
- Selection of technology options from the recommended technology package with farmer participation.
- Implementation of the selected technology options.
- Monitoring and evaluation of technologies coupled with analysis of vulnerability of small farmers to climate risks
- Farmer participatory identification of strategies and measures to enhance resilience of CBFS.
- Assessment of strengths and weaknesses of adaptation options.
- Identification of ways to further improve adaptive capacity based

on experience, field testing for refinement and standardization of adaptation measures.

Successful experience of participatory assessment and refinement for farm level climate resilience

The rich experience of farmers under the demonstration programme paved a way in successfully refining the technologies to suit to the requirements of coastal farmers of South Kerala. To overcome the problems of water logging and salt water inundation, different intercrops like banana (4 varieties), pine apple, vegetables including cool season vegetables, tuber crops, fodder grass, ginger and turmeric were tested for their adaptability. Various intercrops were planted with and without husk burial in the planting pits/application of coir pith compost under coastal sandy conditions and their performance were evaluated. Pine apple was found to be the most ideal crop to withstand water logging, yielding fruits on an average 1.0-1.75 kg. Banana varieties also performed well and bunches weighed on an average of 7 kg for Nendran, 13.5 kg for Njalipoovan and 22.5 kg for Robusta. All the tuber crops (except Colocasia) were found to be affected by water logging. Among the vegetables, amaranthus, bitter gourd, cow pea, tomato, cauliflower and cabbage performed well. Cauliflower weighing up to two kg and cabbage up to 2.50 kg could be harvested. The farmers could get single plant yield up to 18 kg from bitter gourd and four kg from cow pea.

The yield of coconut also showed improvement up to 59% at Arattupuzha and 55% at Alappad. The net income from the coconut based cropping system varied from Rs.1.35 lakhs to Rs.1.89 lakhs depending on the intensity of intercrops cultivated. Several farm level climate smart practices were adopted by the farmers to increase productivity and build resilience in the coastal tracts with climatic vagaries. A modified method of sideways placement of husk around the plant for pine apple showed better performance when compared to normal recommendation under water logged conditions. This has resulted in better growth, early bearing and higher fruit weight for pine apple (average 1.75 kg) compared to normal planted ones (average 1.00 kg). Other climate resilient measures adopted by farmers including shifting

of planting time of tuber crops and banana and standardizing the age of banana suckers for planting were proved to be successful. Planting 4-5 months old suckers of Njalipoovan variety of banana during November-December was found to help tide over the water logging conditions experienced during the early stages of bunch development. Earthing up with silt (150 kg/plant) along with application of 100g of Muriate of Potash/plant at the time of bunch emergence improved growth of plants. By this refinement, the farmers could save 100% of the plants from lodging and poor finger formation due to water logging.

Because of the coincidence of rainy season with growth period of most of the tuber crops, it was difficult for the farmers to raise them under normal planting time. By planting short duration varieties of tapioca like Vellayani Hraswa (5-6 months), Sree Jaya (7 months), and Sree Vijaya (6-7 months) and through advancement of planting time to October-November, the farmers could get a reasonable yield (average 3.2 kg/plant). In case of elephant foot yam and Dioscorea, the farmers retained the previous year's crop in the field and obtained average yields of 6.3 kg from Dioscorea, 5.2 kg from Gajendra variety and 13.5 kg from Peerumedu local variety of elephant foot yam.

Productivity improvements and climate resilient adaptations were found crucial for saving agriculture in such tracts and the reactive adaptation measures viz., modified method of husk burial for pine apple and banana, advancement of planting time, planting of 4-5 months old suckers and earthing up with silt, green manure, coir pith compost and husk for banana, planting of short duration varieties and advancement of planting time for tuber crops undertaken by few farmers were proved to be successful and sustainable to suit to the requirements of small farmers of the Southern coastal areas of Kerala.

Adaptation strategies for upscaling

The adaptation practices identified under this work can further be modified to reduce the vulnerabilities and can be replicated at a wider level by scaling up the adaptation strategies and technologies through community based organizations, which can bridge the adaptation deficit at a regional level. To assist development workers in helping smallholder

farmers, the Integrated Climate Risk Assessment Framework for Small Farmers (ICRAF) developed by Lasco *et al.*, (2011) can be used.

ICRAF is a rapid appraisal tool best implemented by a team of interdisciplinary and inter-sectoral researchers, development workers and farmers. Several approaches can be used to generate and analyze information depending on available resources: focus group discussions, surveys, multi-sectoral workshops, review of literature, GIS mapping, and computer simulation.

Steps in implementing ICRAF

The key steps to ICRAF are: adaptation deficit analysis, identification and prioritization of existing adaptive strategies, building capacity for adoption of identified strategies, planning and implementation of on-farm research along with monitoring. Details of the steps to be followed are

Step 1: Trend analysis of climatic variables in the study areas-Weather variables, mainly variability in rainfall events, maximum and minimum temperature will be analysed.

Step 2: Adaptation deficit analysis-Assess current risks and vulnerabilities of small farmers to climate risks related to variability in rainfall events, temperature and humidity on crops in terms of soil, land and water management practices, time line documentation of pest build up and disease incidence and agro-biodiversity in coconut based cropping systems in the study locations.

- Document local adaptation strategies / agro-ecological practices for enhancing resilience of small holder farming systems.
- Assess the strengths and weaknesses of current adaptation strategies.
- Determine if an adaptation deficit exists.

Step 3: Building adaptive capacity through CBOs.

Approach: Identify/develop sustainable agriculture strategies for enhancing resilience of the coconut based farming systems in coastal areas involving CBOs.

Key activities:

- Collection of current and historical weather data of the project areas from KAU Research Stations, ICAR institutes and IMD
- Agro-biodiversity conservation and utilization: (a) Identification, conservation and collective multiplication of seed varieties which can tolerate droughts, floods, salinity and pests and diseases so as to establish community seed banks for ensuring farmers' access to quality seeds at the right time. (b) Identification, conservation and utilization of the diverse microbial wealth.
- Identify / develop improved land, water and soil management practices such as (a) Improving soil organic matter, soil structure, soil nutrient replenishment, efficiency of nutrient uptake, water infiltration and water use efficiency (b) reducing soil erosion (c) on-farm water and soil conservation and (d) low-cost irrigation systems.
- Identification / development of climate smart management practices like altering planting time, ideal crops and crop varieties, modified planting techniques along with conservation agriculture (CA) including combination of reduced tillage, retention of crop residues / mulching or maintenance of cover crops, crop rotation and intercropping / crop diversification.
- To identify / develop agro-ecological practices like ecological engineering, trap cropping, management techniques utilizing low external inputs and chemicals, biological control measures etc. to manage shifting pest pressures and pathogens due to climate change.
- Diversification of farm and livelihood activities through mixed cropping or polycultures to mitigate risks from extreme weather-related events and other shocks.
- Prioritization of adaptation options by judges rating through multi-sectoral workshops
- Assess strengths and weaknesses (and costs and benefits) of the identified adaptation options.
- Assess future climate risks and what adaptation can be done now.

Step 4: On-farm research, monitoring and refinement of potential adaptation strategies.

This step involves validation of promising adaptation strategies and refinements.

Key activities:

- Developing Climate Resilient Model Farms (CRMFs) through on-farm research and experimentation on potential agro-ecological practices and adaptation strategies identified or developed at field level.
- Monitor and evaluate the strengths and weaknesses (and costs and benefits) of potential adaptation options.
- Assess future climate risks and plan adaptations for future.

Step 5: Knowledge management on climate smart agriculture

Key activities:

- Creating massive climate awareness through multi-sectoral workshops, campaigns, and exhibitions.
- Enhancing extension services on localized climate and weather information systems coupled with climate risk management through capacity building of extension personnel, farmers and local organizations, 'Climate Field Schools' and 'Climate Information Hubs'.
- Strengthening communication and outreach through mass media and ICTs.
- Strengthening CBOs and local institutions for promoting use of natural resources along with protection and management of natural vegetation and sacred groves.

All the above steps require the continued participation of the stakeholders involved along with other concerned community members. The adaptation strategies identified through Step 2 activities can be prepared and implemented, placing emphasis on the need to regularly monitor and evaluate the progress of implementation. Documentation of the individual experiences of farmers can help development and local

government agencies to pick up on best practices which can in turn be recommended to other farmers. The final adaptations developed through on-farm research should be taken up at policy level so as to replicate at the state level as refined technological options in the changing climatic scenario. Extension efforts if focused in this line can build up confidence in the farmers of the coastal tract that there are viable adaptation options that can be implemented at low cost and/or with high benefit - cost ratios.

References

Concepcion RN, Samar E, Collado M. 2010. Multi -functionality of the Ifugao Rice Terraces in the Philippines, Bureau of Soils and Water Management (Philippines), available at http://balitt anah.litbang.deptan.go.id/dokumentasi/prosiding/mfl p2006/ rogelio.pdf.

FAO. 2007. Adaptation to climate change in agriculture, forestry and fisheries: Perspective, framework and priorities, Interdepartmental Working Group on Climate Change, Food and Agriculture Organization (FAO) of the United Nations, Rome.

FAO. 2010. "Climate-Smart" Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation. Food and Agriculture Organization, Rome.

FAO. 2012. Developing a climate-smart agriculture strategy at the country level: lessons from recent experience. Background paper for the Second Global Conference on Agriculture, Food Security and Climate Change. Hanoi, Vietnam.

FAO. 2013. Climate-Smart Agriculture Sourcebook. Food and Agriculture Organization, Rome. Available at: www.fao.org/ docrep/018/i3325e/i3325e.pdf

IPCC. 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Glossary, M. L., Parry, O.F., Canziani, J.P., Palutikof, P.J., van der Linder and C.E. Hanson (eds.), Cambridge University Press, Cambridge, pp. 869-883.

Lasco RD, Habito CMD, Delfino RJP, Pulhin FB, Concepcion RN. 2011. Climate Change Adaptation for Smallholder Farmers in Southeast Asia. World Agro-forestry Centre, Philippines. 65p.

Ray P., Meena, B.L. and Nath, C. P. 2014. Management of Coastal Soils for Improving Soil Quality and Productivity. Pop. Kheti, 2(1):95-99. Available at: www.popularkheti.info

Innovative extension approaches for plantation crops (2016) : 125-130
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Friends of coconut trees – A unique capacity development programme for rural youth to augur sustainable development of coconut sector

Thamban, C.

Introduction

Coconut growers face various constraints to improve farming on a sustainable basis. Lack of availability of labour, especially skilled labour for coconut climbing, and high wage rate are important problems faced by the growers in adopting timely crop management practices. It is in this context that the 'Friends of Coconut Trees (FoCT)' programme implemented by Coconut Development Board to develop a professional group of youth for harvesting and plant protection operations in coconut assumes much significance.

Usually training programmes in agriculture sector target farmers and in many an instances training is equated to a talk by an expert on a selected topic. In Kerala, most of the farmers who are land owners do not till their land themselves; instead they only manage the farm by supervising the agricultural labourers. Under such a situation it is imperative that training on improved farming practices needs primarily target the workers who actually do the farming operations. 'Friends of Coconut Trees', initiated in the background of acute shortage of trained coconut palm climbers for harvesting and plant protection operations, has been quite unique in this regard. The training targeted the group of unemployed youth in developing technical skills, entrepreneurship capacity, leadership qualities and communication skills to address the needs of the coconut growers.

'Friends of Coconut Trees' - Field Experiences

The field level experiences clearly indicate that 'Friends of Coconut Trees' programme has been quite successful in achieving the desired results as indicated by the fact that the initial target of training 5000 youth has been already exceeded. Experiences shared in a meeting held at CPCRI, Kasaragod on 8th May 2012, of about 50 'Friends of Coconut Trees' who were trained at Krishi Vigyan Kendra, revealed that more than 70 per cent of the trained youth render their service to the coconut growers on a regular basis. Out of the 50 members of FoCT participated in the meeting, all were literate except one. Majority (50 %) were having high school level of education. About 10 % of the members were graduates. Before enrolling in the FoCT programme, about 15 per cent of the trainees were having some experiences in climbing coconut palms through traditional method and were earning about Rs. 300-400 per day. They felt that climbing of trees using the mechanical device has substantially reduced the drudgery. The average income of the participants was considerably increased after the FoCT programme. A trained youth, on an average, is able to climb 60 coconut trees and earn an amount of Rs. 750-900 per day. Apart from harvesting, crown cleaning also is done while climbing the trees for which they charge slightly higher wage rate.

All the participants of FoCT programme perceived that the training programme was highly useful. According to them, the coverage and utility of topics included in the programme, apart from use of mechanical climbing device, were very high. They also perceived that the topic related to Integrated Pest and Disease Management was of immediate utility as many of the coconut gardens in the area of their operation were having high level of incidence of diseases like stem bleeding and farmers were quite happy to utilise their expertise in the integrated management of the diseases of coconut palms. The exposure they gained during the training on entrepreneurship capacity, leadership qualities and communication skills also proved to be useful as many of the trainees were able to visit the local Krishibhavans and gramapanchayat offices to interact with the officials and people's representatives. Through these interactions, some of the 'Friends of Coconut Trees'

were able to effectively communicate to the officials and people's representatives and convince them about the need to have integrated coconut development initiatives at the grass root level and also about the readiness of 'Friends of Coconut Trees' to be associated with such initiatives. One of the trainees, Mr. T. K. Sukumaran, Kalakkara House, who was trained in the fourth batch of 'Friends of Coconut Trees' at the KVK, CPCRI, took initiative to organise coconut growers in and around his native place at Kuttikol to form three Coconut Producers' Societies.

The participants were of the opinion that the mechanical climbing device needs to be refined to avoid tear and wear of the device especially for the parts which come into contact with the cables while climbing. They also opined that the device needs to have some safety mechanism attached to it to ensure safety of the climber. Most of the trainees keep the log book recording the day wise details of coconut gardens covered, number of trees climbed etc. so that they can schedule the climbing to meet the needs of coconut farmers in different localities. Some of the participants revealed that farmers were quite happy and appreciated their prompt service in comparison to their earlier bad experiences with the traditional climbers. Mostly the farmers contact the 'Friends of Coconut Trees' through the mobile phone and ensure their services.

Many of the participants revealed that they took initiative to train some farmers and youth in their native place on coconut climbing using mechanical device. It shows the effectiveness of 'Friends of Coconut Trees' programme in terms of horizontal spread of the technology. It was observed that in some localities the 'Friends of Coconut Trees' work as a team of 3-5 members. The unique experience of a five member team of 'Women Friends of Coconut Trees' from Kuttikol gramapanchayat in Kasaragod district is a model of women empowerment through 'Friends of Coconut Trees' programme.

Economic empowerment is the most important gain as each member of FoCT are able to earn on an average Rs 750-900 per day. And there is no dearth of opportunities; only thing is that they are unable to meet the demand from the local coconut growers. The members of 'Friends of Coconut Trees' who were gathered at CPCRI to share their

experiences were unanimous in their perception that their status in the society have gone up and they are proud to be reckoned as a group of resourceful people who are of great help to the farming community rather than mere skilled labourers climbing coconut trees. They opined that they are eager to associate with the coconut growing community for the effective field implementation of coconut development schemes of different agencies.

'Friends of Coconut Trees' for Sustainable Coconut Development – The way ahead

The skilled manpower made available through 'Friends of Coconut Trees' programme is to be effectively utilised for the sustainable development of coconut sector for which appropriate strategies need to be formulated and implemented.

i. Promote group approach among the 'Friends of Coconut Trees'

It would be beneficial if 'Friends of Coconut Trees' of a particular area, say a gramapanchayat, are organised into a group so that their service can be effectively made available for the coconut growers of that locality. Such a team can formulate action plan for a year taking into account the coconut farming situation in the locality. The action plan should consider the requirement for harvesting, crown cleaning, pest and disease management and other crop management practices. It would be useful if participation of coconut farmers through Coconut Producers Societies (CPSs) is ensured in the meeting to discuss and finalise the action plan.

ii. Facilitate Coconut farmer - 'Friends of Coconut Trees' interface

It is essential that cooperation between coconut growers and members of the 'Friends of Coconut Trees' is strengthened in every locality so that the 'Friends of Coconut Trees' can serve the farmers better. The extent and quality of service expected by the farmers and wages to be paid for the service of members of 'Friends of Coconut Trees' of the locality can be discussed in the 'Coconut

farmer - 'Friends of Coconut Trees' interface programme. The interface programme can be facilitated at gramapanchayat level.

iii. Participation in the implementation of coconut development interventions

Various agencies, including Coconut Development Board, Department of Agriculture, Local Self Governments and other agencies, implement schemes for coconut development, mostly through farmers' cluster approach. The components of such schemes include coconut nursery management for quality seedlings, integrated nutrient management, multiple cropping, pest and disease management and value addition through product diversification. A formal mechanism to ensure the participation of the team of 'Friends of Coconut Trees' of the locality in the field level implementation of such interventions is highly necessary for the effective implementation of coconut based interventions envisaged under various schemes. Hence, the action plan of the 'Friends of Coconut Trees' should also reflect the requirement of their services for the field implementation of coconut based interventions through different schemes in the locality.

iv. Need based Training of 'Friends of Coconut Trees'

It is necessary to organise training on regular basis for the members of 'Friends of Coconut Trees' depending on the specific needs to enhance their technical capabilities and managerial efficiencies. Apart from the use of mechanical climbing devices, topics related to pest and disease management and other crop management practices should be included in such training programmes, depending on the needs of the locality. Central Plantation Crops Research Institute, Kerala Agricultural University and Krishi Vigyan Kendras can provide the technical support for conducting the training programmes.

v. Participatory Approach and Functional Linkages

The functional linkage between various agencies related to coconut development including research, development and extension is to be strengthened to enhance the effectiveness of implementation of

coconut based interventions at the grass root level. The effectiveness of coconut development schemes can also be enhanced through ensuring the participation of coconut growers and the members of 'Friends of Coconut Trees' in the field level implementation (Fig. 1).

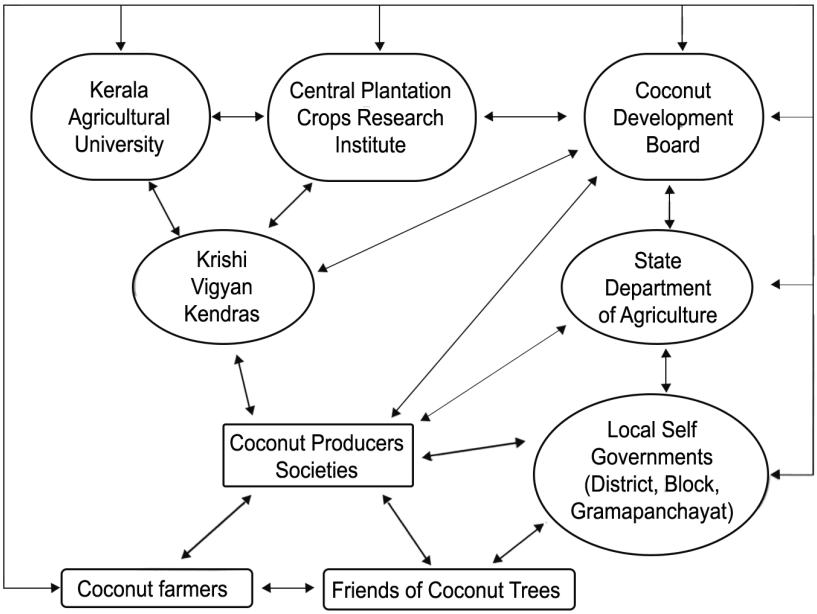


Fig. 1. Strengthening functional linkages among different agencies for sustainable coconut development

The platform provided by the ongoing programme of decentralized planning by the local self governments at the district, block and gramapanchayat levels can be effectively utilised for formally coordinating the activities of various coconut development agencies through a participatory approach. Coconut Producers Societies and the team of 'Friends of Coconut Trees' can also substantially contribute for the effective coordination at the grass root level as active partners in coconut development initiatives.

Innovative extension approaches for plantation crops (2016) : 131-140
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Farmer producer organisations in coconut sector

Jnanadevan, R.

Introduction

Organizing the unorganized coconut sector through farmer's collectives is one of the most important activities of Coconut Development Board (CDB).The CDB has been taking up this task during the last five years facilitated formation and hand holding of FPOs. With the strenuous efforts taken by the Board aggregation of primary coconut producers, especially small and marginal farmers, into producer collectives has become a reality. The primary objective of mobilizing farmers into member-owned producer organizations is to enhance productivity and promote economically desirable product diversification and marketing for enhancing profitability of coconut farming, especially small farmers in the country. The participant farmers will be given the necessary support to identify appropriate production and protection technologies for increasing production by optimum use of inputs, use of intercrop relevant to their coconut garden, access to modern technology through community-based processes including Field days, seminars, training programmes etc. The producer's collective's will have to be strengthened and they will be facilitated to access forward linkages with regard to technology for enhanced productivity, value addition of feasible products and market tie-ups. Like co-operative system a three tier coconut farmers collectives was formed which would be supported under the programme to form associations/organizations relevant to their context including confederating them into FPOs for improved input and output market access as well as negotiating power. Coconut farmers are organized into small neighborhoods informal groups at grass root level as Coconut Producers Societies (CPS) and 10-12 CPS

federated in to Federations at middle level and 10-12 federations to form producer companies at top level.

Farmer Producer Organisation (FPO)

Farmer Producer Organization is formed with the main objective of socio economic development of farmers through

- Productivity improvement
- Cost reduction
- Efficient aggregation
- Processing for value addition
- Better by-product utilization
- Efficient marketing of the produce

It aims at providing a fair, steady and remunerative income to farmers by organizing the unorganized coconut sector through farmer collectives.

Structure of FPOs

The Coconut Farmers Producer Organizations thus formed have a three tier structure as depicted below (Fig.1)

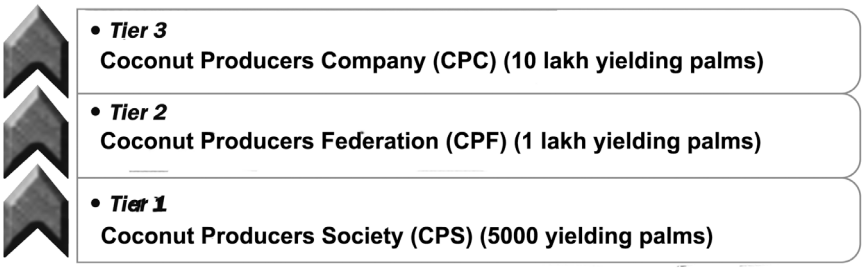


Fig.1. Three tier structure of FPOs

Tier 1: Coconut Producer Society (CPS) – the Foundation

Coconut Producer Society (CPS) is the grass root level farmer organization. It is formed by 40-100 coconut farmers in a contiguous area organized into a group. Around 4000-6000 yielding palms in the catchment area is necessary. Farmers with a minimum of 10 palms are only eligible to be a part of this society. Once the society is formed, it is registered under charitable societies act and also with Coconut

Development Board. All the societies have a common bye - law. Forming CPS proves to be advantageous to farmers by

- Increasing production and productivity
- Decreasing the cost of production
- Aggregation of primary produce
- Initiating primary processing activities
- Group Approach
- Reduction of wastage
- Total inclusive growth of Farmers

The formation of Coconut Producer Societies (CPS) is depicted in Fig. 2.

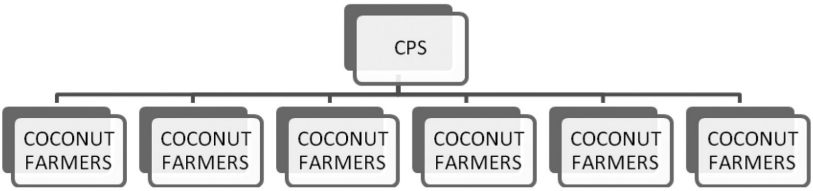


Fig. 2. Formation of Coconut Producer Societies

Tier 2–Coconut Producer Federation (CPF)

Coconut Producer Federation (CPF) is formed by combining minimum of 8 CPS. A CPF would have around 1, 00,000 palms under it. CPF is also registered as a charitable society and further registered with CDB. Coconut Producers Federation (CPF) is the intermediate tier above CPS (Fig. 3) and performs following activities

- Ensure integrated socio economic advancement of the member CPSs
- Undertake R&D activities in coconut based farming
- Disseminate latest technologies in production, procurement, processing and marketing of coconut
- Make available good quality seedling to CPSs
- Undertake pooling and collective marketing of the produce of the CPS

- Identify good quality mother palms from among CPS
- Procure coconut for processing into copra, in order to ensure fair price for the produce and to avail the benefit of Minimum Support Price(MSP) to the member CPS

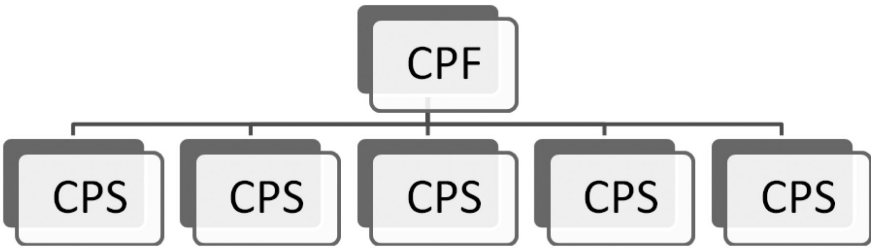


Fig.3. Formation of Coconut Producer Federation (CPF)

Tier 3–Coconut Producers Company (CPC)

10-15 CPFs would join together to form a CPC (Fig.4). A CPC would consist of around 10, 00,000 yielding palms. This company would be registered under section 581B of Indian Companies Act of 1956. The Producer Company is wholly and fully owned by the farmers. Farmers are the shareholders of the company. The authorized capital envisaged for the Coconut Producer Company is Rs. 5 Crores. Companies are also expected to collaborate with technical and financial institutes, research institutes, management institutes and other consultancies for acquiring the expertise required to move in the right direction during its initial stage. Activities to be undertaken by CPCs include

- Coordinate and strengthen activities of member CPS/ CPF
- Establish the capital base of Company by bringing equity
- Procurement of produce and primary processing
- Rejuvenation of gardens
- Neera production, procurement and processing
- Coordination with other Coconut PCs
- Adherence to statutory formalities
- Logical scaling up of CPS and CPF to PC for ensuring sustainable income
- Decision making for sustained development of stakeholder (farmer)

- Capacity building and trainings for representatives from CPF and CPS
- Venturing into product diversification, processing and export.
- Brand building and market development

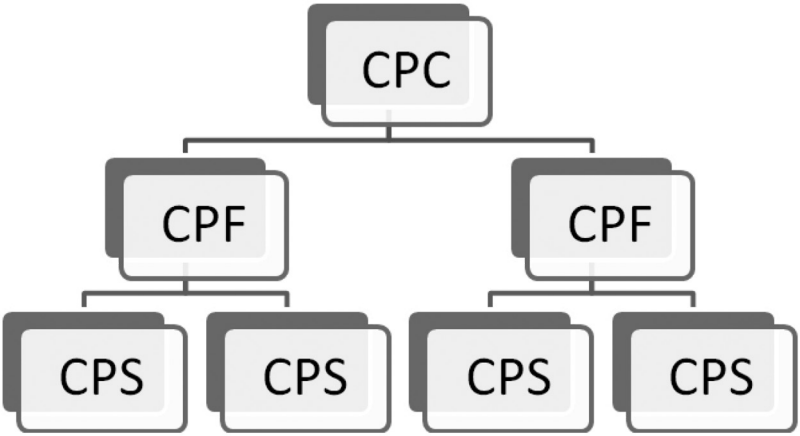


Fig.4. Formation of Coconut Producer Company (CPC)

The Board has initiated the formation of Coconut Producer Societies (CPS) in 2011-12 by associating 40-100 coconut growers in a contiguous area with a consolidated minimum of 4000-5000 palms. The objective is socio-economic upliftment of the farmers through productivity improvement, cost reduction, efficient collective marketing and processing and product diversification. A farmer equity contribution is also proposed to be mobilized. A matching equity contribution will be sought from the state Government as a onetime assistance for making the CPS effective. At present, 9498 CPS, 734 CPF and 67 CPC are formed in different states. State wise 3 tier FPO formed are given in Table 1.

Table 1. Coconut Farmers Producer Organizations in India

S. No.	States	No. of CPS registered	No. of CPF registered	No. of CPC registered
1	Kerala	7188	461	29
2	Tamil Nadu	573	66	17

3	Karnataka	397	125	13
4	Andhra Pradesh	1089	82	8
5	West Bengal	199	0	0
6	Odisha	21	0	0
7	Assam	23	0	0
8	Gujarat	7	0	0
9	Maharashtra	1	0	0
	Total	9498	734	67

Unlike other companies these coconut farmers' producer companies are formed by the farmers, for farmers and owned by them. Primary coconut producers or the farmers are the owner of the company. It functions like any other private limited company with only difference being that profit accrued flows back to the farmers who own the company. These FPOs' act as economically viable, democratic and self governing Farmer Producer Organizations (FPOs) by extending various services to farmers in production, processing and marketing.

Farmer Producer Organization (FPOs) is widely followed in the states like Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Odisha, West Bengal, Gujarat and Assam. This system is successfully established in coconut sector in Kerala and has 29 CPCs within the state. Tamil Nadu has 17 CPCs, Karnataka has 13 CPCs and Andhra Pradesh has 8 CPCs. States like Odisha, West Bengal, Gujarat and Assam are on an emerging stage and has registered Coconut Producer Societies (CPS).

The strong foundation

The Board conceptualized a systematic method for the aggregation of coconut farmers. A three tier system of formation of farmer collectives getting federated at each level was the modus operandi of CDB. We started with small, grass root level collectives comprising of 40-100 farmers since small groups increase cohesively. Any farmer who has a minimum of 10 bearing coconut palms is eligible to become a member of the farmer collective. These farmers cultivating in contiguous areas will have a minimum of 4000-6000 coconut palms which provide them with adequate marketable surplus to initiate a marketing or

processing endeavor. The Farmer collectives were registered under the Indian Societies Act, 1860/Travancore Cochin Literary, Scientific and Charitable Societies Act, 1955 and named Coconut Producer Societies (CPS). CDB has developed a common bye law for the CPS. CPS forms the foundation for the three tier network of farmer collectives conceived by CDB. The objective is socio-economic development of the farmers through productivity improvement, cost reduction, efficient aggregation, marketing and processing for value addition and by product utilization.

The CPS functions on the concept of inclusive growth. The group is formed on a basis of a knowledge based, farmer centric, non subsidized approach and advocates a group approach in crop production, post harvest handling, processing, value addition and marketing. The CPS is first facilitated to develop a database on the extent of coconut cultivation in its area of operation including details of bearing palms, non bearing palms, varieties grown etc. This database will provide the necessary information for planning the activities of the CPS towards ensuring an enhanced and sustained income. The CPS is facilitated to conduct regular group meetings and undertake pro-active measures towards increasing productivity through synchronized cultural operations, rejuvenation of gardens through systematic replanting, timely harvest of produce by effective utilization of Friends of Coconut Tree and collective marketing. CDB extends support to CPS for establishment of nurseries to cater to the demand for seedlings among the member farmers. CDB also facilitates establishment of organic manure units at the CPS level.

Coconut Producers Federations (CPF)

The CPS are further federated to form Coconut Producers Federations (CPF) by integrating 15-25 CPS. The federation will be having around 1 lakh coconut palms in its area of operation which will provide adequate raw material for the initiation of a coconut processing unit. The federations can also undertake efficient byproduct utilization for increased returns. On the production front, CPFs can embark into R&D activities in coconut farming with the association of research institutes thereby enabling demonstration of already developed technology and

also development of innovative technology in a participatory and need based manner. Federations can identify good mother palms in the area and enter into seedling production for ensuring good planting material supply. Federations can aggregate coconut for collective marketing either for domestic market or export or also for processing activities. CPFs can take a lead role in ensuring adequate and timely credit to the coconut farmers through Kisan Credit Cards (KCC). CPFs can empower the member farmers and undertake processing of coconut and production of various products from coconut. Monitoring of the activities of the member CPS and engineering the formation of new CPS in potential areas. Federations, with the rich base of coconut palms in its area of operation, can create a chain of tender coconut parlours in major tourist destinations and public places. Enterprises like coconut chips production, minimal processing of tender coconut, copra production etc are activities that can be undertaken by CPF.

Coconut Points/Kiosk established

Coconut point is an outlet/kiosk of CPCs established for marketing all kinds of quality products made from coconut. The objective is to establish a retail network of outlets for coconut and coconut based value added products across all the states so as to make the products available throughout the country. Till now CPCs have established 150 coconut kiosks and Board had released the one time grant of Rs.163.52 lakhs to 134 coconut points @ 50% of the cost for setting up of kiosk, limiting to a maximum grant of Rs.1.50 lakhs to each coconut point as reimbursement.

Neera

A few CPCs in Kerala namely, Palakkad, Vadakara, Karappuram, Kaipuzha, Thirukochi, Kuttiady, Tirur, Perambra, Kadathanad, Tejaswini, Kodungallur, Thrissur and Thiruvananthapuram are involved in Neera extraction.

Copra and Coconut Oil

The Coconut Producer Federations are procuring coconuts and processing it into FAQ grade copra in the modern copra dryers

established by them. 30 copra dryers have already been established by the federations. The copra produced by the federations is utilized by Coconut Producer Companies to manufacture coconut oil and market it in their own brand. Vadakara, Kodungallur, Tejaswini, Palakkad, Kozhikode, Karappuram and Onattukara are currently manufacturing copra and coconut oil. Pollachi CPC in Tamil Nadu is involved in producing organic coconut oil from coconuts procured from its member farmers. They are currently producing 10 MT organic coconut oil per day and marketing it in their brand name 'IMAYAM'. Five CPCs in Andhra Pradesh, namely Mahima, Noveeal, Sri Ramakrishna, Ubhaya Godavari and Chaitanya are in the process of establishing modern copra dryers with a capacity to process 10,000 coconuts per day to produce FAQ grade copra.

Ball Copra

Kalpatharu CPC in Karnataka is involved in the production and marketing of ball copra procured from its member farmers. The company procured 75 MT of ball copra during the financial year 2016-17. They had supplied 45 MT of ball copra for exporting to Japan and China. About 30 MT of ball copra has been supplied to up country markets directly. Noveeal CPC in Andhra Pradesh is in the final stage of establishment of ball copra manufacturing unit with a production capacity of 50 lakhs nuts per annum.

Tender coconut

Econut CPC in Karnataka is involved in marketing of tender coconuts by establishing kiosks at various locations in Bangalore. The company procures tender coconut from its member farmers at reasonable rates and sells an average of 700 tender coconuts per day through each of these kiosks.

Conclusion

Going forward, CDB plans to form 100 Producer Companies, 1000 CPFs and 20,000 CPS in the country. The purpose behind the same is that at least 10% of total production and value addition happening in coconut sector should be through Producer Companies. Only in

such a situation would the actual bargaining power reside in hands of farmers. Besides, this would also encourage new entrepreneurs to establish business in this sector as the issue of aggregation and organized availability of raw materials would be addressed through FPOs.

References

Kalyanjibhai Mohanbhai. 2015. Indian coconut FPOs the best international model, Indian Coconut Journal, 8

Nair, Deepthi. 2013. Producer companies: the new outlook in the global world, Indian Coconut Journal, 56(5) 15-16.

Razak Abdul. 2014. FPOs take up organic farming, Indian Coconut Journal, 14-15

Sebastian, K, S. 2013. Farmer Producer Organisations: Mantra for new green revolution, Indian Coconut Journal, 56(4) 8-11.

Sharma, Pravesh. 2013. Promoting farmer producer organisations to mitigate risk and improve market access: Lessons and challenges, Indian Coconut Journal, 56(5) 8-11.

Thomas Simi. 2014. FPOs get deep rooted in Karnataka, Indian Coconut Journal, 27-28

Innovative extension approaches for plantation crops (2016) : 141-149
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Women empowerment through coconut based micro enterprises - The success story of Subicsha

Kunhammad Master, M.

Introduction

SUBICSHA, (SUstainable Business Development of Innovative Coconut Based MicroenterpriseS for Holistic Growth and Poverty Alleviation) an innovative coconut based value added products venture, was developed jointly by Perambra Block Panchayath and Indian Institute of Management-Kozhikode, with basic intention of providing employment opportunities to the members of 522 SHGs in Perambra Block Panchayath. The project proposals envisage development of micro enterprises that could be effectively managed by women self help groups from BPL families active in the project area. All these micro enterprises are limited to dependence on coconut, the most abundant resource available in the area. The project aims to attain the novel objectives of poverty alleviation, women empowerment, social development and farmer friendliness. The innovative coconut based products number to around 24, out of which twenty are developed and marketed.

The people in the area feel much enthusiastic about the project, which is evident from the rapidly progressing turnover of the company from less than a lakh 5 years ago to more than 1.25 crores recently. A remarkable feature of this achievement is that this could be gained without the application of modern marketing techniques or publicity campaigns. It is worth mentioning here that the social and economic objectives of the project are being steadily met with in the recent years. Subicsha's intervention in the market has been instrumental in reducing exploitation of farmers by business community.

Milestones in the history of the company

The project preparation team was constituted in the year 2000 under the aegis of Indian Institute of Management Kozhikode and the detailed project report was submitted to Govt. of India in 2002. The main objectives of the project are as follows;

- To create micro economic enterprises
- To eradicate poverty.
- To generate employment opportunities for BPL families
- To empower women self help groups by intensive training and financial assistance for starting self employment ventures.

The detailed project report submitted to the Govt. of India was duly approved with a special status under SGSY scheme. The herculean task of organizing more than 512 SGSY units was completed within a short spell of time fulfilling the required formalities under the scheme and inauguration of the project was done on 31st October 2003.

Starting with house centered production units manufacturing and selling Soaps & pickles. Subicsha SGSY units slowly and steadily entered the local market. It was not so easy to capture the market, which was already flooded with similar products with which the poor women folks had to encounter with. Mustering full courage and facing the odds in the marketing arena, unsupported by scientific publicity techniques or media support, the production and marketing groups could present a wonderful performance. During this time the architects of the project were deeply engaged in setting up of Virgin Coconut Oil production units in 5 of the 7 Panchayaths under Perambra Block.

Three copra dryer units which were established by Perambra Block Panchayath as a part of women development programmes earlier were, in the mean time, transferred to SUBICSHA. Situated at Cheruvannur, Nochad, and Kayanna these units were revamped and production of copra was taken over by SUBICSHA SHGs. In the mean time 2 Oil extraction units one at Cheruvannur and the other at Nochad were also put into operation.

The next venture to come to production stream was the Virgin Coconut Oil units which were established with technical guidance from an Australian company. RUBCO arranged collaboration, technology transfer, import of machines and equipments from Australia. The marketing arrangements were made under agreement with Rubco.

An agreement was made in the year 2006 between Subicsha and Rubco in respect of marketing of Virgin Coconut Oil under which the entire products could be taken over by them. This was one of the greatest milestones in the history of Subicsha. Though it had independent status under the Govt, the financial support was slowly withdrawn and it had to generate sufficient revenue to run the business. The company steadily increased its production, sales and resultant profit to make it stand on its own feet.

The necessity for establishing a quality control lab was felt at this stage but the finance aspect posed the biggest problem. The Coconut Development Board, as in the past came to the rescue of company and a full-fledged laboratory was set up at the headquarters of SUBICSHA. This was later instrumental in awarding AGMARK registration to the Company by Ministry of Agriculture, Govt. of India.

When we think of coconut based products, we cannot forget the coir and its allied products. A number of SHGs was to be engaged in this sector. To meet the requirements of fibre for these units, it became a necessity to establish a fibre production unit. The unit was set up at Kadiyangad in Changaroth Panchayath. Naturally, while producing fibre from coconut husk, a large quantity of Coir pith would form as a by-product. It is not easy to discard this material nor is it advisable to do so. Converting the pith into biofertiliser, was considered and a plant was set up at the same site for the purpose. Unprecedented support was offered by the farmer community for this product resulting in excellent sales.

The organisation

The unique features of SUBICSHA can be seen in the organizational structure too. Everything required for a corporate establishment can be seen here, but with a difference. The workers, supervisors, specialists

and managers all are shareholders of the company. This is termed as the most unique feature of the organization. Being a federation of SHGs, and shareholders themselves being the employees, there is no employee employer classification, nor there was any wage structure. As the entrepreneurs themselves manufacture the product, inspect, pack and market, the need for close supervision is not much significant. Intensive and extensive training imparted to the incumbents have already inculcated discipline among the Subicsha staff. As in the case of any corporate establishment, the company has implemented departmentalization and functional relationship in the company in successful manner. Board of Directors, Resource Counsellors and Preraks look after the managerial functions. They are all part of SHGs.

Apart from training up the SHGs, to make them fit for various types of jobs, the company also carries out certain activities on behalf of the member SHGs. These activities include wholesale purchase of raw material from market at a cheaper rate, and supply to production units, organizing marketing activities, obtaining technologies and implementing them, modernizing the systems such as packaging etc., forming new groups and training them to take up new projects. The company explores new avenues of activities on a continued basis, so that ventures for employment opportunities and income generation can be brought to Subicsha.

Training

To facilitate upgradation of technologies and familiarization with new ideas Subicsha staffs are periodically trained in its training facility centre at the head office. Apart from this, the facility centre conducts training/courses to new entrepreneurs at their request subject to certain conditions. This continuous process of receiving and imparting training, goes on in the organization due to which capability of staff in the relevant fields is always kept at higher level at all times. Subicsha has the distinction of giving training in production of coconut based products to self help groups in Kavarathi Panchayath.

It is worth mentioning here that a number of dignitaries from abroad as well as inside the country visit the plant to know, how the organization

functions. This includes entrepreneurs, officials at various levels of central as well as State Governments. As a part of its training activities, students from a number of colleges within and outside Kerala do their project work under guidance from the training faculties attached to SUBICSHA.

Achievements

Subicsha is the first organization in Kerala to form a federation of women self help groups and register as a producer company under companies act 1956. While many self help groups spread over in the whole of the state, could not survive the stiff resistance from the major corporates, and were nipped in the bud, this premier organization formed itself as a strong fort, and could march forward to success, year after year. After establishing the brand name, Quality control system and well planned production activities, the company could market a sizable portion of its products almost all over Kerala State. Participation in festival sales, melas, Govt. organized sales campaigns under various agencies, direct marketing, house to house sales etc., have helped in propagating the products among the people all over the state as well as outside Kerala. The products received wide spread acceptance and is acclaimed everywhere for its highest quality and moderate pricing. The Company has been able to develop market even in northern parts of the country such as Chandigarh.

Quality Control Lab set up by the Coconut Development Board has been instrumental in maintaining the standard of the product, and maintaining AGMARK certification as well as FPO license. Reforms in packaging systems are another remarkable achievement under financial assistance from NABARD. Eventhough the marketing support and publicity factors are in short, it is more or less compensated by extreme hard work and concerted effort put in by the enthusiastic sales personnel of the company. During the last few years, the company has been able to establish four outlets in Kozhikode city besides developing agencies for Thrissur, Palakkad, Malappuram, and Kannur districts.

Contribution of Subicsha in the economic progress of Perambra Block Panchayath cannot be viewed as trivial. Active intervention in the

market during the crisis period, has helped coconut farmers of the Block Panchayath to fetch better prices for their products. Manufacture and supply of coir pith based bio fertilizer at affordable prices could increase the fertility of the soil to a reasonable level in the project area. If the production of fertilizer is stepped up, perhaps the entire Block can be relieved off from the use of chemical fertilizers in course of time. Of course, the availability of sufficient husk for the production poses a problem in the present conditions.

The self help groups forming the part of the company have been immensely benefited by way of enhanced income from their activities under support provided by Subicsha. The income generated is from self employment without affecting the normal sources. This is the most outstanding innovative feature of the establishment. Group insurance scheme introduced by the company to its SHG members have contributed considerably towards increasing the confidence level of these women folks during past few years. The social status, attitudes, standard of living etc., have resulted in dynamic changes in their life style. The income generation which could be achieved in the recent years, is in the range of Rs. 100-200 for those who work regularly for least 4 hours a day.

Products

There are 24 value added coconut products envisaged in the project. These can be divided in to 4 categories such as food, cosmetics, fertilizer and industrial products. Virgin coconut oil is the most important revenue earning product. Coconut based pickles, jam, coconut powder, chutney powder, chips, sweets, squash, vinegar, toilet soaps, hair care, shell charcoal, coir fibre, coir and coir pith fertilizer etc., are a few other products manufactured in the concern. Certain items with lesser shelf life such as snowball have also taken place in the product list. Most of the products have found their way deep in to the minds of customers. The company proposes to produce coconut oil on a mass production basis, processing 10 tons of copra per day. Erection and commissioning of machines and equipments are completed and the plant will go in to production stream by the end of December 2011. This plant is of the most modern type in respect of quality and quantity.

Institutional support

The Indian Institute of Management Kozhikode, prepared the project report in detail and with its full support and dedicated effort, approval from various Govt. agencies could be obtained on time bound basis. Adequate managerial support, advises and suggestions followed before, during and after the inception of the project, from this prestigious institution, and it still continues.

The vital role played by the Coconut Development Board in bringing up SUBICSHA to the present level is uncomparable. Financial, technical and moral supports given by the institution include development of coconut cluster, establishment of a full-fledged laboratory at the head office, experimental project in collaboration with KFRI etc. Advises on effectively managing the institution came in from this august institution, regularly without which SUBICSHA could not have progressed to the present level. The immense support given by CDB in marketing the products is unforgettable.

RUBCO, another premier institution in Kerala, was instrumental in obtaining manufacturing technology for Virgin Coconut Oil and import of related machineries and spares from Australian company. Besides these the institution came forwarded with full marketing support in respect of VCO under an agreement with SUBICSHA.

Technical know-how in respect of managing the institution was provided by NIRD which later on approved SUBICSHA as a role model for other institutions and references were and are still made in their training programmes.

CFTRI, KILA, KFRI, Spices Board, NIT, IRTC Palakkad, KITCO and CPCRI are other institutions which provide technological support for SUBICSHA. The services include development of new technologies and products, besides imparting training to staff employed for manufacturing activities related to various products. Financial support for modernization of packaging systems from NABARD is an important step forward in the history of the company.

Publicity and Marketing

SUBICSHA has adopted different marketing strategy. Establishing its own outlets in the project area and at Kozhikode city appointing of dealers in Malappuram and Kannur Districts, door to door sales by Subicsha member SHGs and supplying of goods by delivery van, are a few techniques adopted. Participation in organized sales campaigns by Kudumbasree units, Onam sales festivals, national fairs, world trade fairs etc., are the other avenues explored during the past few years as part of marketing activities.

House centred production and marketing activities are carried out by a number of SHGs and the products are delivered to SUBICSHA. It is to be noted that a sizable portion of the products are marketed by such groups themselves and the remaining products are deposited with SUBICSHA, which accounts for, as a sizeable portion of the turnover of the company.

Awards and recognitions

Subicsha was awarded by Ministry of Agriculture, Govt. of India, under the aegis of CDB, for its excellent performance as best co-operative society, in the year 2006 and 2011. The local self Govt. department, Govt. of Kerala awarded Swaraj Trophy award to Perambra Block Panchayath twice, for which leading role was played by Subicsha. Pazhassiraja Charitable Trust also bestowed upon the company its coveted Rajakeeyapuraskar award in the year 2007. NIRD, State planning board, Kerala Agricultural University and many other research scholars have included 'Subicsha' as part of their research studies.

Conclusion

The traditional belief that coconut is useful only to produce oil and coir products, have been proved to be incorrect, by SUBICSHA. It is proved that more than 41 products could be successfully manufactured and marketed from this single raw material, that too by a section of women from BPL families belonging to remote villages, with no noteworthy background to claim. SUBICSHA in the yesteryears have proved that even SMEs can survive the stiff competition from corporate giants by

forming federation of tiny enterprises under one umbrella as Producer Company and function effectively. Being part of such an experiment, Subicsha will always be a role model, with its success story for other such organizations. The need of the hour is modernization in all levels of production, quality control and marketing together with introduction of new products.

Innovative extension approaches for plantation crops (2016) : 150-155
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Farmer field schools for technology transfer in plantation crops

Sunil, V. G., Berin Pathrose and Nija George

Introduction

A farmer field school (FFS) is school without walls and group of farmers meet together in one of their fields to learn about their crops and various factors that affect the crops. They learn how to improve their farm by observing, analysing and trying out new ideas on their own fields. This innovative approach to adult education first developed in Southeast Asia for pest management. It was developed as an alternative to the conventional top-down extension approach and is based on the concepts and principles of people-centered learning. It makes use of innovative and participatory methods to create a learning environment, including learning networks. In this new approach, the farmers have an opportunity to learn for themselves about particular crop production problems, and ways to address them, through their own observation, discussion and participation in practical learning – by – doing field exercises. It teaches basic agricultural and management skills that make farmers experts in their own farms. The FFS system further helps to improve the decision making capacity of farming communities and encourages the local innovations (Gwary *et al*, 2015).

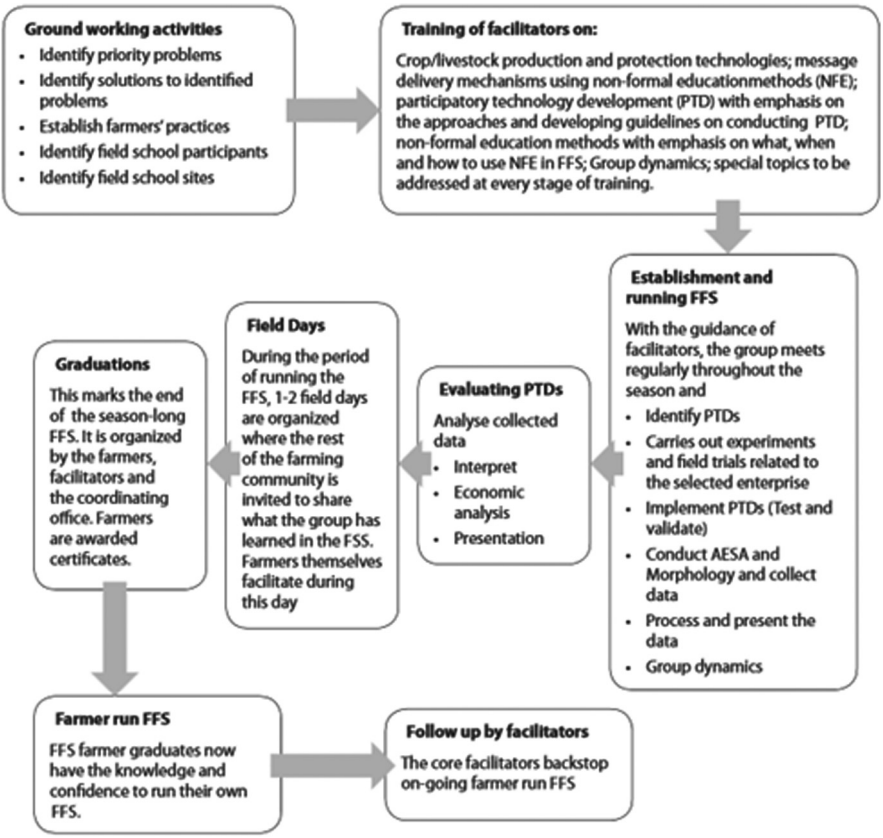
Elements of Farmer Field School

1 **The group**: An assembly of individuals who have a common interest forms the centre part of FFS. These groups comprising of 20-25 members may be formed afresh for the purpose of FFS or by strengthening the interaction among members of existing groups.

2. **The Field**: The field is the learning place or class room and the materials like plants, pests, soil and other facilities in the farmers' field turn out to be the basic learning material. After the preliminary observation and exploration of the field, the group may be provided with a shaded area to be used for follow-up discussions and exchange of ideas.
3. **The Facilitator**: The facilitator can be an extension agent or a Farmer Field School graduate competent enough to lead group members through the hands-on exercises. The facilitator guides the group, helps them decide what they want to learn and think of possible solutions, and advises them if they have questions.
4. **The curriculum**: The natural cycle of the subject concerned, viz., crop, animal, soil, or handicrafts forms the curriculum for FFS. All the events happening in the FFS field is focussed in parallel with different aspects of the subject to be covered.
5. **Programme leader**: The programme leader serves a co-ordinator's role by organizing the field activities, supporting the training of facilitators and engaging the members in a participatory way to solve problems in participatory ways. The leadership qualities of the programme leader empower the group members.
6. **Budget**: This is an important element that determines the actual implementation of FFS. The financing vary largely depending on who implement them and how they are conducted. (SUSTAINET EA, 2010)

Steps in Conducting Farmer Field School

The various components of extension education system play crucial role in the successful conduct of the FFS. Farmers being the experts conducting their own field studies, extension agents acts as facilitators empowering farmers to reach at their own decisions and refinements. Unlike other learning situations, group dynamics provide for the implementation of these decisions on farmers' fields. Conducting FFSs involves the following steps incorporating different elements effectively (SUSTAINET EA, 2010).



Benefits of FFS

The farmers meet every week from planting to harvest or in a predetermined schedule, to check on how the crops are growing, look at the amount of moisture in the soil, count the numbers of pests and beneficial creatures such as earthworms and spiders. They do experiments in the field. The extension approach help in imparting the required knowledge and skill related to cultivation as there was a frequent contact between the farmers and the facilitators and the farmers' queries were cleared then and there. Farmers develop a regular habit of visiting their field and monitoring crop pest and diseases. Farmers are able to take the right crop management decisions at every stage of the crop. Few ITKs (Indigenous technical knowledge which was of low cost and effective) can be recorded and tested through FFS

farmer's field (Gwary *et al*, 2015). Farmers' field schools contribute efficiently to sustainable livelihood development through capacity building, promoting equity and equality, along with improving social and technical competency of the farmers (Butt *et al.*, 2015). The outcome of FFS can be utilized to identify researchable issues, to find out practical solutions and for policy development (3IE, 2014). Group dynamics, participatory group presentation and discussion can be made part of the programme. As a result, a sense of cooperation and team coordination develop among the farmers. This will helpful in spreading and sharing the technologies with each other. The farmers draw on their own experience and observations, and make decisions about how to manage the crop. The group must hold two or more field days to show other farmers what they are doing.

Areas for FFS in Plantation crops

The topics of FFS vary widely from region to region, it being primarily conducted for IPM technologies and rice in South East Asia while extending to different husbandry practices in African countries (Anandajayasekeram *et al.*, 2007). However, the FFS in plantation crops need to be looked separately from annual crop. Here, we cannot cover the complete life cycle of the crop in a single FFS. Only certain practices that meet our requirement should be identified for the FFS.

Topic 1: IPDM in coconut plantations: According to the severity of infection of various pests and diseases, the topics for each class can be structured. Red palm weevil management in coconut using pheromone traps can be one. Here, the area wide management strategy needs to be emphasised. The use of Mancozeb sachet against bud rot can be another topic. The drenching of manure pits with Beauveria bassiana to control grubs of rhinoceros beetle can be another one. Similarly, the preparation of Trichoderma enriched compost against stem bleeding can also be experimented. The group members should also be asked to compare the result from each item.

Topic 2: In situ production of green manure and organic manure: The use of organic manures is important to achieve sustainable yields. In situ production of green manure can help the farmer to reduce

the cost of cultivation. FFS can be conducted in this topic. Together with it, technology for coir pith composting, vermicomposting of palm leaves through earth worms etc. can also be included in the syllabus.

Topic 3: INM practices and use of micro nutrients: There is an increasing need to correct the acidity of the soil by adding lime or dolomite. The importance of soil testing and adopting soil test based recommendation can be covered. Similarly, the need for going for micronutrient fertilizers containing boron, zinc, magnesium and calcium etc need to be emphasised.

Topic 4: Intercropping in coconut gardens to augment income: Various intercrop options can be introduced and tested as a FFS. The options can be vegetables, tuber crops, spice crops, medicinal plants etc. according to the local situation. The production technology can be discussed. Other enterprises like apiculture, sericulture, mushroom, etc. can also be looked into.

Topic 5: Soil and water conservation measures in coconut gardens: Irrigation can double the yield of coconut. Hence, various water conservation measures that can be adopted in coconut gardens need special emphasise. The practice of husk burial can also be included. Various soil conservation practices can be demonstrated to the farmers through FFS (http://www.myradakvk.org)

Topic 6: Quality seedling production for coconut nurseries: There is increasing demand for quality seedling production. FFS on seedling production is a new area. In areas of availability of trained climbers, hybridisation may also be covered under FFS.

Topic 7: Post harvest processing in coconut: A number of new products can be made from coconut. The prominent among them include neera, virgin coconut oil, snow ball, coconut chips, coconut vinegar, desiccated powder etc. FFS on preparation and marketing of a few of the products can be undertaken.

Topic 8: IPDM in arecanut: Various disease and pest affects the yield of arecanut. The prominent among them include mahali, inflorescence die back, yellowing, spindle bug etc. Organic and inorganic options in managing the diseases can be discussed.

Topic 9: Post harvest operations in cocoa: Cocoa is a crop that is gaining popular now a days. The fermentation, drying and secondary processing aspects of cocoa bean can be taken as an FFS.

Topic 10: IPDM in cocoa: Squirrels, rodents, mealy bug tea mosquito bud and diseases like pod rot, black pod etc. is seen largely in cocoa growing areas. An FFS on IPDM on such problems can be undertaken.

Conclusion

The field schools are a way for farming communities to improve their decision making and stimulate local innovation for sustainable agriculture. The emphasis is on empowering farmers to implement their own decisions in their fields.

References

Anandajayasekeram, P., Davis, K. E. and Workneh, S. 2007. Farmer field schools: An alternative to existing extension systems? Experience from Eastern and Southern Africa. Journal of International Agricultural and Extension Education. 14(1): 81-93.

Butt, T.M., Gao, Q. and Hussan, M.Z. 2015. An analysis of the effectiveness farmer field school (ffs) approach in sustainable rural livelihood (SRL): The experience of Punjab-Pakistan. Agricultural Sciences. (6): 1164-1175.

Gwary, M. M., Muhammad, A.F. and Mustapha, S.B. 2015. Review of Farmer Field Schools Approach to Extension Service Delivery: Utilization and Impact in Nigeria. World J. Agric. Sci.11 (4): 229-238.

3IE. (International Initiative for Impact Evaluation).2014. Systematic Review Summary 1. Farmer field schools from agricultural extension to adult education. 52p.

SUSTAINET EA 2010. Technical Manual for farmers and Field Extension Service Providers: Farmer Field School Approach. Sustainable Agriculture Information Initiative, Nairobi.

http://www.myradakvk.org/

http://www.atma.ind.in/farm-field-school/

Innovative extension approaches for plantation crops (2016) : 156-163
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Interactive video conferencing for research - extension - farmer interface in plantation crops

Thamban, C. and Chandran, K. P.

Introduction

There is a great transformation in agriculture owing to changes in the economic and trade environment along with production challenges. To cope with these changes, the farmers need timely information on what to produce, when, where and how to produce and what advances have been made in this front. It is essential to create the Information and Communication Technology (ICT) infrastructure in rural areas for effective dissemination of information which needs some kind of institutional mechanism. A sustainable model needs to be worked out for making the benefits reach to all. Videoconferencing is such a medium of communication with enhanced proximity among the participants which is so vital in technology transfer process. It provides means for audio and visual communication over telephone lines or internet.

Systematic research conducted at Central Plantation Crops Research Institute (CPCRI) has yielded a substantial number of viable technologies related to crop production, crop protection and processing for enhancing income from coconut, arecanut and cocoa farming. However, farmers are not able to exploit the production potential from these technologies to the extent desirable. Low efficacy of transfer of technology and feedback system is an important constraint in improving technology utilization by coconut farmers to earn more income. Effective linkages between research, extension and farming community are a crucial requirement for sustainable coconut development. There is great potential for the use of Information and Communication Technology

for enhancing the efficiency of technology transfer initiatives for improving coconut farming. Interactive Videoconferencing, as an ICT tool, provides two-way point-to-point or multi-point video and audio connections. As videoconferencing becomes more widely available, it is important that there is a new awareness of its vast potential in order to ensure that this technology is fully exploited for the benefit of farmers. Innovative extension approaches, including interactive videoconferencing as part of cyber extension, are being employed by CPCRI for improving technology utilization by farmers.

Interactive videoconferencing for organizing Research-Extension -Farmer interface programmes

As part of the cyber extension activities, a group video conferencing system through ISDN was installed at CPCRI, Kasaragod to facilitate interaction between various stakeholders for enhancing technology utilization in coconut. The Research-Extension-Farmer Interface facilitated through video conferencing under Cyber Extension Project was formally inaugurated at CPCRI, Kasaragod during the year 2007 (Thamban *et al.*, 2013). Since then, the Institute has been organizing interface programmes involving different categories of stakeholders at regular intervals to strengthen the technology transfer efforts. In the year 2010, the videoconferencing facility for organizing interface programmes was strengthened by procuring a mobile CODEC. The additional facility of mobile CODEC enhanced the scope of interface programmes by linking the scientists at the Institute headquarters with farmers and other stakeholders in distant locations, which do not have videoconferencing facility, either through ISDN or IP-network. WiMax facilitiy with ensured bandwidth was exploited for the purpose. 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 details of interface programmes facilitated through videoconferencing organized by CPCRI are furnished below.

Table 1. Research-Extension-Farmer interface programmes facilitated by videoconferencing organized by CPCRI

Interface programme	**Participant at the Institute**	**Participants at the off-campus**	**No. of programmes 2007-2016**
Type -1	Scientists	Extension personnel and Farmers	17
Type -2	Scientists	Farmers	14
Type -3	Scientists	Extension personnel	19
Type -4	Extension personnel	Scientists	06
Type -5	Scientists and members of SHGs	Scientists and members of SHGs	06
Type-6	Scientists+ Students	Scientists from other institutes	06
		Total	68

A total of 68 interface programmes facilitated through videoconferencing were organized by CPCRI during the period from 2007 to 2016. The programmes thus organized can be broadly categorized as follows.

Type 1: Scientists of the institute interact on themes related to production technologies of coconut and coconut based cropping systems with extension personnel and farmers located in distant places. Mostly this type of interface programmes have been initiated in collaboration with commodity boards such as Coconut Development Board (CDB), State Department of Agriculture/Horticulture and Krishi Vigyan Kendras (KVKs).

Type 2: Scientists of the institute interact with farmers located in distant places. Mostly this type of interface programmes have been initiated at the request of commodity based farmers' groups such as coconut farmers groups.

Type 3: Scientists of the institute interact with extension personnel attending training programmes at other horticulture research institutes on topics related to coconut based cropping systems.

Type 4: Interaction is facilitated between extension personnel attending training programmes at CPCRI and scientists at other horticulture research institutes on themes related to improved varieties and agro techniques of horticulture crops suitable for inter/mixed cropping in coconut gardens.

Type 5: Interaction between SHGs are facilitated mainly to share their experiences in production and marketing of value added products and also to facilitate demonstration of techniques involved in the production to benefit the members of SHGs at the other end of interaction.

Type 6: Here, major transaction of the information is mainly academic in nature. A virtual class room environment is created with closer interactions.

Mode of interactive videoconferencing

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. Scientist-Extension personnel interface programmes on specific themes use power point presentation by the scientist followed by discussion. The interaction between SHGs employ demonstration of techniques of production of value added products, question-answer and discussion.

Linkages

Effective linkages are established with various agencies such as ICAR institutes, Commodity Boards like CDB, State Department of Agriculture/Horticulture, State IT Misssion, NGOs, people's representatives and farmer organizations for the effective conduct of the interactive videoconferencing programmes by CPCRI to strengthen technology transfer programmes in coconut, arecanut and cocoa under the cyber extension project (Thamban, 2010).

Locations of interactive videoconferencing

Since launching the facilities, interactive videoconferencing involving various stakeholders have been conducted between CPCRI headquarters at Kasaragod and various locations in the country as per the details furnished in Table 2.

Table 2. Locations of interactive videoconferencing

State	Locations covered
Delhi	New Delhi
Andhra Pradesh	Hyderabad
Assam	Guwahati
Bihar	Patna
Orissa	Bhubaneswar (Pitapally)
Karnataka	CDB Bangalore, IIHR, Hesserghatta
Tamil Nadu	Chennai, Coimbatore
Kerala	Thiruvanthapuram, Vellanad, Varkala, Kallada, Kollam, Kayamkulam, Alappuzha, Kochi, Thrissur, Malappuram, Kuttippuram, Tirur, Valanchery, Vadakara, Kalpetta, Kozhikode, Kannur and Kanhangad

All the four major coconut producing states viz., Kerala, Tamil Nadu, Karnataka and Andhra Pradesh have been covered through the interface programmes besides other states such as Assam, Bihar and Orissa. In Kerala, more number of locations have been covered through the interactive videoconferencing due to the comparative advantage of arranging the logistics for the use of mobile CODEC equipments.

Subject matter areas covered in the interactive videoconferencing

The details of subject matter areas covered in the interactive videoconferencing programmes involving scientists and farmers are furnished in Table 3 below.

Table 3. Subject matter areas covered in the interactive videoconferencing

Topic	**Coverage (%)**
Availability of planting materials	4.4
Hybrids and improved varieties	8.8
Cropping/farming systems	5.9
Integrated nutrient management	5.9
Organic farming technologies	1.5
Irrigation and water management	5.9
Integrated pest management	20.6
Integrated Disease management	19.0
Post harvest technology	11.8
Development schemes and Marketing	8.8
Activities of other ICAR institutes	7.4

As is evident from the above table, crop protection aspects were the subject matter area, which got maximum coverage in the interactive video conferencing programme, followed by post harvest technologies, improved varieties and Development and marketing. Incidence of pests and diseases is the most important field problem resulting in substantial loss in income of farmers and hence, farmers showed keen interest to seek technical guidance from the scientists on integrated pest and disease management practices.

Perception of farmers about the interactive videoconferencing

Majority of the farmers rated the interactive videoconferencing they have attended as very useful indicating a high level of utility for the programme. Through these interface programmes, farmers at distant locations were able to have one to one interaction with scientists and could get technical guidance on various field problems experienced. Similarly, most of the farmers rated the quality and utility of the audio-visual aids used in the interactive videoconferencing programme as very good. According to farmers, the effectiveness of interface programmes facilitated through videoconferencing can be further

improved. Conducting the interface programmes in a scheduled manner with intimation to farmers sufficiently in advance, ensuring participation of representatives of developmental agencies to provide information on schemes to provide support for farmers for field implementation of improved technologies, selecting a specific theme for each interface programme rather than a broad topic, organizing follow up programmes for the interface such as diagnostic field visit and conducting training programmes to scale up the technology transfer initiatives were the major suggestions of farmers for improving the interactive videoconferencing.

Conclusion

CPCRI has launched cyber extension activities utilizing the videoconferencing facility covering various parts of the country as part of strengthening the technology transfer programmes of the Institute in mandate crops viz., coconut, arecanut and cocoa. The video conferencing facility is effectively utilized for scheduling and implementing interface programmes at regular intervals involving various stake holders including researchers, extension personnel, farmers and entrepreneurs. It enables Interaction of farmers at remote villages with the subject matter specialists of the institute and other centres thereby reducing the time, effort and cost in transfer of know-how from lab to field.

Experiences of CPCRI have clearly shown that interactive videoconferencing as an ICT tool can be effectively used for linking research, extension and farming community. Farmers have perceived high utility for the interface programmes facilitated through videoconferencing since they were able to have one to one interaction with scientists and could get technical guidance on various field problems experienced in coconut farming. There is scope to further enhance the effectiveness of interface programmes conducting follow up programmes. Advances in video communication with mobile applications of high bandwidth could be further exploited to enhance the efficiency and coverage of the technology transfer initiatives.

References

Thamban, C., Muralidharan, K. Ravikumar, N. and Amarnath, C.H. 2013. Videoconferencing for organizing research-extension-farmer interface programmes. Indian Coconut Journal Nov. 2013, 31-33.

Reddy, P. P. 2014. Biointensive integrated pest management in horticultural ecosystems. Springer India. 271p.

Thamban, C. 2010. Extension approaches to enhance technology utilization and income generation in coconut farming. In. Proceedings of International Conference on Improving Productivity and Profitability in Coconut Farming (Eds. George V. Thomas V Krishna Kumar and B. Augustine Jerard), October 25-28, 2010, CPCRI Kasaragod. 443-456 pp.

Innovative extension approaches for plantation crops (2016) : 164-170
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Information and communication technology tools for technology transfer in plantation crops

Sivakumar, P. S.

Introduction

Information and Communication Technology (ICT) are diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information (Nath, 2001). The ICTs comprise of hybrid devices of computing and networking technologies which have capability to improve intra and interpersonal, group and mass communication. These "new media" ICTs combine on any different configurations of communications like interpersonal communication (e.g. interactivity, demassification, and synchronization) and the characteristics of mass communication (e.g. massification, usage of new technology and offer unlimited possibilities for connecting people across the several classes and regions. These developments created new opportunities for the extension workers to perform the information dissemination, capacity building and technology application more effectively. Table 1 presents various potentials of ICTs for use in extension.

Table 1. Potentials of ICTs and its technologies

Potential	Aspects	Technologies
Creation	Creating audio-visual content	Personal Computers, Digital camera, Scanner, Smartphone
Processing of information	For communication, problem solving and decision-making	Calculator, Personal Computers, Smartphone

Storage	Storing audio-visual information and written materials	CD, DVD, Hard disks, Pen drive, Microchip, Cloud
Display	Projecting and displaying information and materials	PC, TV, Projector, Smartphone
Transmis-sion	Transmitting information from one place to others across the distance	Internet, Teleconference, Video conferencing, Mobile technology, Radio
Exchange	Exchange of information between and across medium	Email, Smartphone

ICTS in agriculture

ICTs can be used in extension for four purposes (i) Information provision, (ii) Facilitate decision-making; (iii) Capacity building; and (vi) Facilitation in farming operations.

(i) Information provision

- Process within which information is provided to users or users' community without any individualization of content or purpose.
- Common way of supplying technological and other related information to the farmers and other stakeholders

(ii) Facilitate decision-making

- Process of helping the stakeholders with customised information to solve a problem or aid in decision making
- Providing market price information, pest and disease forecasting, climate prediction and advisory are common forms of decision-support approaches.

(iii) Capacity building

- Developing new capacities of refining existing skills through training and support programmes delivered offline or online.

- Delivering multimedia training programmes (online or offline) designed to improve knowledge, develop or refine skills

(iv) Facilitation in farming operations

- Developing methods, tools and gadgets which help the farmers in farming, value addition and marketing.
- Devises which generate sounds to prevent wild animals entering field

Cases of ICT use in Plantation crops

(i) Decision making (*http://keralacoconut.com/*)

Information system for Startup management

The Palakkad Coconut Producers' Company Limited in association with Source Trace Systems (STS) has launched an integrated farm information system, which would enable farmers' start-ups to monitor their operations with state-of-the-art information system and optimise it by right decisions on checks, balances and well informed strategies. The software for the farm information system is built on software as a service platform (SaaS) in order to shift the entire investment weightage to shared platforms like Cloud with strong encryptions.

Information system for (b) TropGeneDB

(http://tropgenedb.cirad.fr/tropgene/JSP/index.jsp)

TropGeneDB is an information system developed by CIRAD (French Agricultural Research Centre for International Development) to manage various kinds of data on tropical crops including coconut. It is a Web application based on MySQL databases (one per crop) that can be queried using Java customizable interfaces automatically generated to fit the databases contents. TropGeneDB is a database that manages genomic, genetic and phenotypic information about tropical crops. It is organised on a crop basis.

TropGeneDB can record crop information on:

- Molecular markers, QTLs, genetic and physical maps
- Genetic diversity, association and linkage disequilibrium studies

- Phenotypic diversity studies based on agro-morphological traits or traits measuring the susceptibility/resistance to aggression (diseases, salinity, drought)
- Geographic origin, parentage, collection, ecology

Data on the following 10 crops are currently recorded in TropGeneDB: Banana, breadfruit, cocoa, coconut, coffee, cotton, oil palm, rice, rubber tree, sugarcane. All the data in TropGeneDB are public and generally linked to published scientific papers.

ii) Capacity building through e-learning

E-learning is a novel approach to train a large number of extension personnel over distances in a short time. E-learning refers to the learning that is delivered, enabled or mediated using electronic technology for the explicit purpose of training. E-learning includes both one-way and two-way exchanges as well as learner-to-learner interaction (Fee, 2009). The term e-learning is synonymous with multimedia learning, technology-enhanced learning (TEL), computer-based instruction (CBI), computer-based training (CBT), computer-assisted instruction or computer-aided instruction (CAI), internet-based training (IBT), web-based training (WBT), online education, virtual education, virtual learning environments (VLE) and digital educational collaboration. This approach transforms the learning process by integrating different media such as text, picture, audio, animation and video to create a multimedia instructional material in such a way that it promotes reading interests and willingness of the learner to learn. It also customizes the learning process to student's needs in terms of study style, time and space.

Application of e-learning in extension training

E-learning has wider applications in extension. It can be used effectively in distance education, self-learning and blended learning i.e combining face-to-face teaching with e-learning. Realising the power of e-learning, several countries have utilised the e-learning methods and tools to reach the "poorest of the poor" for equitable delivery of development benefits. The "e-Learning for Agriculture and Fisheries" programme of Philippine's Department of Agriculture (http://e-extension.gov.ph/elearning/), Computer-Based Agricultural Extension Program

(CBAES) of Korea (Park *et al*., 2007), self-paced e-learning course on food security of FAO (http://www.foodsec.org), e-learn agriculture (http://elearnagri.iasri.res.in/) and Learn Rice (http://learnrice.in/) of India are few successful e-learning initiatives targeted to agriculture students and extension clientele. Few studies conducted in developed countries like USA have demonstrated the effectiveness of e-learning in extension work. Lippert *et al*., (1998) conducted a study on delivering training via internet among extension personnel from South Carolina, Georgia, and Alabama counties and found that the agents participated enthusiastically in the training and liked the novelty of the learning method. Another research work conducted by McCann (2007) with extension agents of Mississippi State University Extension Service, USA showed that the agents liked interactive online environment than face-to-face training.

Though e-learning is an effective method of delivering instruction over distances, developing the content and presentation are the critical steps in ensuring effective learning. Development of content and design of e-learning materials are skilful processes that need expertise in instructional design and media skills. As the technology advances and pressure to develop e-learning materials in a short-time, the instruction design is often poorly treated resulting in poor learning materials (Moloney, 2010). Studies conducted among extension personnel in USA (Thomas *et al*., 2008) and Iran (Ahmadpour and Mirdamadi, 2010) indicated that poor instructional or course design as important constraint that affect the success of e-learning in extension.

(iv) Facilitation in farming operations

(a) Wild Animals Voice Sound Generator for arecanut and banana

In Goa and forest prone agriculture area, there is a big challenge of monkeys spoiling the arecanut and banana plantation. They easily cross the electronics fencing but are scared due to the loud sound of tiger or elephant. But, these monkeys are so clever that once they get acquainted with the cycles of the sounds, they are not scared. So, there are few ICTs in India creating different sounds at different time cycles so as to confuse the monkeys. The sounds are generated by an amplifier

powered by solar and controlled by Remote control (http://www.nanoganesh.com/)

(b) Using drones for mapping and inspection in coconut gardens

http://ictupdate.cta.int/2016/04/21/counting-coconuts-with-drones/

In 2015 the Samoan agricultural non-governmental organisation (NGO) Women in Business Development Incorporated (WIBDI) used Skyeye owned drones i.e. fixed wings professional mapping UAVs for mapping the operations in coconut gardens. The drone captures images of farms that are not easily accessible and fly as per the requirements. The drones were specifically use for mapping the boundaries, collect data for forecasting etc. the yield and production of virgin coconut oil. By the end of January 2016, Skyeye had mapped 10,480 hectares by drone and counted 138,180 coconut trees.

Conclusion

Information and Communication Technologies are wonderful tools for extension work and have proven to be effective for information provision, facilitating decision making, capacity development and facilitating farm operations. Considering the high investment in ICTs , there is an essential need to develop sound strategies to integrate ICTs into extension for maximising their effectiveness.

References

Fee, K. 2009. Delivering e-learning: A complete strategy for design, application and assessment. London: Konkan Page.

Lippert, R.M., Plank, O., Camberato, J., and Chastein, J. 1998. Regional extension in-service training via the internet. Journal of Extension, 3691). Avl in: http://www.joe.org/joe/1998february/a3.php.

Moloney, K. 2010. There is no excuse for bad instructional design. Training & Development in Australia. Available in: http://www.aitd.com.au/_literature _77356

Nath, V. 2001. Empowerment and Governance through Information

and Communication Technologies: Women's Perspective, The International Information & Library Review, Vol. 33, pp. 317–339.

Park, D.B., Cho, Y.B., and Lee, M. 2007. The use of an e-learning system for agricultural extension: A case study of the Rural Development Administration, Korea. The Journal of Agricultural Education and Extension. 13(4): 273-285.

Innovative extension approaches for plantation crops (2016) : 171-190
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Indigenous technical knowledge and farmer innovations for sustainable development of plantation crops

Sakeer Husain, A.

Introduction

India has made tremendous progress and development in agriculture and allied fields especially after Green Revolution. Green Revolution was achieved with the use of modern system of agricultural production consisting mainly of high yielding varieties, chemical fertilizers, pesticides and sophisticated equipments. Consequently, the emergence of modern technologies and intensive use of inputs also resulted without considering their adverse impact on environment and sustainability. Despite the substantial increase in crop yields, these modern technologies have required heavy investment on costly external resources of uncertain future availability. These technologies also resulted in the rapid erosion of crop and livestock diversity, natural soil fertility and biological pest regulation, enhanced soil salinity and environmental problems, reduced the nutrition once received from 'wild' foods on farms, increased the need for expensive and toxic chemical inputs, and finally made the farmers more dependent on markets and outside agencies resulting in an imbalanced growth between rural and urban areas.

Today the attention is shifting to a sustainable form of agriculture to ensure the attainment and continued satisfaction of human needs for the present and more importantly for the future generations. In this context, planners and policy makers have started thinking of alternatives to the so called modern farming. Organic farming is being suggested by

many as the best alternative, which is almost a revival of the traditional agriculture practiced by our forefathers, with some modifications. At the same time, there could not be any organic farming strategy excluding indigenous knowledge/practices which have been developed by our ancestors over centuries of trial and error with nature and its factors. Thus the latest trend all over the world is unravelling the indigenous knowledge as an alternative to high external input agriculture.

What is indigenous knowledge?

Indigenous knowledge refers to the unique traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area. (Grenier, 1998). Indigenous Technical Knowledge (ITK) is the treasure of knowledge that the people in a given community have developed over time and have been passed on from generation to generation. It is not a one-time technology. It is generated based on practical knowledge and wisdom of indigenous people, tested for its effectiveness and hence transferred to the succeeding generations. It is therefore eco-friendly, sustainable and in turn human-friendly.

- According to ICAR (2002), indigenous knowledge is the participant's knowledge of their temporal and social space. Indigenous knowledge as such refers not only to knowledge of indigenous people, but to that of any other defined community.
- According to World Bank (1998), the special features of ITK are: it is local and rooted in a particular community; it is tacit knowledge and not easily codifiable; transmitted orally; experiential rather than theoretical knowledge; learned through repetition and constantly changing.
- The term indigenous knowledge is used synonymously with indigenous technical knowledge, traditional knowledge, local knowledge, folk knowledge, traditional wisdom, and wisdom of elders. Seeland (2000) observes that these synonyms refer to the local origin and promotion by a community. However, IK is dynamic and not static as the word 'traditional' commonly implies. As Berkes (1999) rightly puts it, traditional does not mean an

inflexible adherence to the past; it simply means time tested and wise.

- Further, IK is the social capital of the poor, their main asset to invest in the struggle for survival, to produce food, to provide for shelter, or to achieve control of their own lives. In the words of Husain (2010), indigenous practices in agriculture are those practices developed and/or adopted by the farmers of a specific geographical area to solve their problems and/or fulfill their requirements in the cultivation of crops, with much reliance on local inputs and internal solutions. Indigenous knowledge in agriculture may be classified into different types such as information, practices and technologies, beliefs, tools, materials, experimentation, biological resources, human resources, education, and communication (IIRR, 1996). In the field of agriculture, ITKs are available in all the areas of crop production, crop protection, post- harvest management and natural resource management for agriculture.

Importance of indigenous knowledge

IK systems have views different from the conventional modern research practices. Its strategies are totally eco-centric, objective as well as intuitive, and they are derived from practical and innovative life of the generations. (Rajagopalan, 2003). The indigenous knowledge systems and technologies are readily available, socially desirable, economically affordable, and sustainable, and involve minimum risk to rural farmers and producers, and above all they are widely believed to conserve resources. (Grenier, 1998). Thus the indigenous agricultural practices are cost-effective, time-tested, eco-friendly and serve to sustain the agricultural development.

IK can play as a strong alternative to the present modern technologies. As Rajagopalan (2003) rightly puts it, the modern science is partial and technological which is totally dependent on laboratory based experiments and innovations. Modern science uses the knowledge about the nature only in a technological way, in the process of which major part of the essence is lost. Ethnic people have acquired knowledge about their surroundings through hundred of centuries which makes the modern science only a secondary source.

Thus, IK which is developed and adapted continuously to gradually changing environments and interwoven with the cultural values people is a strong, eco-friendly and viable alternative for sustainable agricultural development.

Types of indigenous knowledge

The types of indigenous knowledge could be classified as follows (IIRR, 1996)

Information - Trees and plants that grow well together

Indicator plants that show soil salinity or wilting point

Practices and Technologies - Seed treatment and storage methods, bone setting methods, disease treatments etc.

Beliefs - Holly forests protected for religious reasons

Tools - Equipment for planting and harvesting, cooking pots and implements

Materials - House construction materials, materials for basketry handicrafts etc.

Experimentation - Healers' tests for new plant medicines

Biological resources - Animal breeds, local crop and tree species

Human resources – Specialists such as healers and black smiths

Education – Traditional instruction methods, apprenticeships etc.

Communication – Stories and messages carved on palm leaves, folk media, traditional information exchange.

There can have ITK on all aspects of crop cultivation such as varieties, climate and season, soil, seeds, preparatory cultivation, sowing/ planting, water management, nutrient management, intercultural operations, weed management, plant protection, harvest, post-harvest and value addition etc.

Sources of indigenous knowledge

According to IIRR (1996), indigenous knowledge or the practices could be collected from the following sources:

1. Community members, especially the elders
   - Indigenous experts (such as a farmer particularly skilled in a specific area)
   - Indigenous professionals (such as healers and irrigation specialists)
   - Innovators (people who experiment with and develop new techniques)
   - Intermediaries (those who pass on messages such as "town criers" and messengers) and
   - Recipient disseminators (all those who receive information, modify it and pass it on).
2. Folk lore, songs, poetry and theatres
3. Community records like writing, painting and carvings. Records can also consist of trees planted as boundaries, notched poles, bones and many other forms.
4. People working with communities such as extensionists.
5. Secondary sources include published and unpublished documents, databases, videos, photos, museums and exhibits.

Methods of collecting indigenous knowledge

The methods through which the indigenous knowledge or the practices could be collected are:

- Interviews with indigenous specialists
- Case studies
- Field observation
- In depth interviews,
- Participant observation
- Participative techniques
- Surveys
- Brain storming
- Games
- Group discussions
- Village level workshop
- Participatory videos and photos

- Key informants
- Case histories
- Observation of technology in operation
- Controlled trials
- Unstructured exchanges
- Agro-eco system analysis
- Participatory Technology Development
- Travelling to interior regions

Significance of documenting indigenous knowledge

Indigenous knowledge should not be considered as primitive, being left over from the past. On the contrary, it should be treated as knowledge systems well-tuned and adapted (both biologically and socially) to counter the processes of what are often harsh and inimical environments. It represents adaptive evolution in which the vagaries of climate, availability of land and water, basic needs of the people and their animals for food, shelter and health have been amalgamated in a system that has allowed the society to exist and develop in the face of tremendous odds (Sreekumar *et al*., 2006).

According to Sundaramari *et al*. (2008a) the indigenous practices incur low or no cost thereby yielding higher cost-benefit ratio. Further the indigenous practices can play a vital role in the design of sustainable and eco-friendly agricultural systems, increasing the likelihood that the rural populations will accept, develop and maintain innovations and interventions and this will in turn lead to sustainable rural development.

Unfortunately, majority of our treasures of indigenous knowledge are being lost or at the brink of extermination due to the lack of its proper documentation coupled with invasion of modern knowledge. If people's knowledge has not been recorded, it would remain largely inaccessible to development workers, later leading to its extinction. Hence, traditional agricultural practices must be understood and conserved preferably in a data base form as quickly as possible before they are lost with the rapid advancement of modern agriculture in developing countries. Along with its documentation, an in-depth analysis of such knowledge including the rationality and validation studies would also be of high value.

If indigenous knowledge has not been documented and compiled, doing so should be a research priority of the highest order. Indigenous knowledge is being lost at an unprecedented rate, and its preservation, preferably in data base form, must take place as quickly as possible (National Research Council, 1992).As stressed by Sikhana (1994), the study of indigenous knowledge is important in planning and implementing new programmes. These are the entry points for future scientific work and development of appropriate and acceptable practice.

Indigenous knowledge in Plantation crops

Plantation crops constitute a large group of crops in India. They include coconut, arecanut, oil palm, cashew, tea, coffee rubber and cocoa. They play an important role in view of their export potential as well as domestic requirements and in providing sustainable livelihood to the rural poor. They are essential ingredient of economic security.

Coconut is a traditional plantation crop in India, with a long history of cultivation and considerable indigenous wisdom (Kumar, 2008). Likewise, many of the horticultural crops including arecanut, cashew, coffee are traditionally grown in India. Naturally there will be abundant traditional wisdom concerned with these crops, though there can be variations in the ITK from place to place.

Documented ITKs

Many researchers like Somasundaram (1995), Rambabu (1997), Sundaramari (2001), Sreekumar *et al.*, (2006), Husain (2010) have made attempts to document ITKs. Indian Council of Agricultural Research (ICAR) has also made an attempt to document the Indigenous Technical Knowledge (ITK) through its Nation Wide Mission Mode Project on Collection, Documentation and Validation of ITK under NATP during 2000-2003. In the effort to document the indigenous knowledge, ICAR could document 4033 indigenous technical knowledge and practices in agriculture and allied areas described under 23 thematic areas, among which one of the areas was 'Horticultural crops' which include plantation crops. Presently there are three volumes published by ICAR viz., Inventory of Indigenous Technical Knowledge in Agriculture-Document 1, Document 2, and Document 2 (Supplement1). [ICAR (2002); ICAR (2003a); ICAR (2003b)]

To have an indication of the ITK, a few of them as reported by different authors are presented below:

Sl. No	Indigenous Horticultural Practices	Reported from	Reported by
1	Dusting of ash to control pests	Tamil Nadu	Chittiraichel-van and Ra-man (1990)
2	Camel dung (4- pellets) is placed near the rat burrows in the field and home so that the rats move away without causing destruction	Sabarkantha district of Gujarat	Mane(1990)
3	To advance germination of coconuts, place them in standing water of an open irrigation well. After one month or so, the sprouted nuts are transplanted to the field.	Una, Himachal Pradesh	Narsinhbhai (1993)
4	By placing fine coral gravel in the crown of coconut trees, the rhinoceros beetle is deterred from burrowing and feeding	Maldives	Hunter (1996)
5	To prevent rats from climbing coconut trees, a large palm leaf is split along its mid rib; one set of leaflets is wrapped around the trunk below the crown and the other set is wrapped in the opposite direction	Maldives	Hunter (1996)
6	The base of coconut trees is covered with coconut fronds to prevent direct sun from drying out the stem and to keep the base cool. Also the leaves decompose to get organic manure	Andaman and Nicobar	Bandyopa-dhyay and Saha (1999)

7	Cow dung slurry is sprayed over the areca nut seedlings in the nursery once or twice a week to control common pests and diseases	Karnataka	Prakash (1999)
8	To check dropping of immature nuts, a trench is dug at 4 feet distance from the tree and filled with 5 kg of neem leaves and 25kg. of green leaf manure and covered with soil	Karnataka	Prakash (2000)
9	Buffalo dung is mixed with water and kept in coconut gardens to attract rhinoceros beetle.	Kerala	Bonny (2001)
10	Drawing the picture of snake on the trunk of coconut to control the damage of tree dogs.	Villupur-am, Tamil Nadu	Purushotha-man (2003)
11	Smoke frequently by burning coconut husks during evening hours in the garden prevents rhinocerous beetle	Palakkad District of Kerala	Swapna (2003)
12	The bamboo drip irrigation system	Jaintia and Khasi hills, Meghalaya	Singh (2007)
13	Using the termitary of black ants to drive away red ants in coffee plantations.	Guinea, Africa	Sonomou (2008)

Some of the ITKs documented and rationalised by Husain in 2010 are reported hereunder.

The nuts formed in 'Thiruvathiranjattu-vela' (June- July) will mature in February – March and are good for seed nuts.	'Thiruvathiranjattuvela' (June- July) is a rainy period, which is highly favourable for the development of nuts, due to good moisture and nutrient uptake by the palms. Hence the nuts formed in this period will have better growth and development, and will serve as good seed nuts.
While selecting seed nuts, discard 2-3 nuts adjacent to spathe.	Flower opening, fertilization and nut development in a bunch begins from the distal end and proceeds down. So the nuts in the distal end will have a temporal advantage and will have more nutrient mobilization capacity due to increased hormonal status. Such nuts will have more vigour as compared to the last formed nuts at the proximal end that are seen adjacent to spathe.
Harvested seed nuts are to be kept upside down for around 1 month.	By keeping the nuts in inverted position, the embryo will be in a stress situation which prevents it from germination. Besides, the embryo gets moisture and better nutrition during this period. This, together with the release of stress during sowing, facilitates faster germination.
Prepare nursery bed for coconut with a mixture of soil and sand.	The mixture of soil and sand is an ideal medium which enables good soil aeration and root spread, prevents/reduces termite attack due to the cuticular abrasion caused by the sand on the body of termites, provides better drainage, enhances germination, and finally helps in easy lifting/uprooting of seedlings.

After 1-2 months of sprouting of seed nuts, it can be transplanted in the main field.	This indigenous practice greatly reduces root damage and transplanting shock. It is practically more successful in areas where water logging is a problem during rainy season. In such cases, planting may be done immediately after the heavy rains, so that 1-2 months old seedlings will establish more easily than 10-12 months old ones.
The coconut seedlings if planted in summer will become sturdy. Plant during the months of January-February, if irrigation is possible.	The seedlings planted in summer get hardened. They will get rooted in the transplanted area before the onset of monsoon. Thus it can very well utilize both the monsoons and grow well. This is advisable only if irrigation is possible. Otherwise the seedlings may experience water stress, as the root growth will be insufficient to draw water to meet the evapo-transpiration demand.
Put rice chaff in coconut basin; no other irrigation is needed, and the yield will be doubled.	Rice chaff can hold large quantity of water without much evaporation loss, percolation loss and run off loss. Kerala is a state with an average rainfall of 300 cm which is well distributed. Rice chaff stores water during these rains and makes it available to the palms. It is proven that availability of sufficient water to coconut palms increases the yield enormously.
Shake non bearing coconut palms with the help of an elephant. The palm will start bearing.	It causes stress that stimulates plant growth. Shaking the palm gives a shock treatment which stimulates the plant to enter in to reproductive phase. (The practice of providing stress is scientifically accepted for inducing flowering).

Putting 'Erukku" (Calotropisgigantea) leaves & 'Ungu' (Pongamiapinnata) leaves in coconut basin will reduce pests and diseases.	Both the plants have antimicrobial and insecticidal properties. They are rich in tannin and phenols which are inhibitory to grubs and pathogens in soil. Pongamia has insecticidal properties and the Pongamia oil from leaves is a growth inhibitor. Pongamia contains alkaloids- karangin, pongamol etc. known to be nematicidal. Calotropis contains insect repellent substance- calotropin, an active poison of digitalis type (Yellow bitter resin).
While putting cow-dung in the Farm yard manure pit, apply salt in between layers, to destroy the grubs of Rhinoceros beetle.	The practice affects the osmotic balance of grubs. Salt may kill fleshy grubs by exosmosis. The principle of exosmosis leads to plasmolysis of the grubs due to highly concentrated salt solution resulting in rupture of skin, loss of water and death of the grubs. Thus, high salt concentration inhibits multiplication and growth of the pest. But, salt may deteriorate the nutrient status of cow dung.
To destroy the grubs of rhinoceros beetle put leaves of 'Peruvalam' (Cleroden-druminfortunatum) in Farm yard manure pits.	The leaves and plant parts have insecticidal principles. Thus the leaves have repellent as well as antifeedent effect. The chemicals released by the decay of leaves are inhibitory to the grubs, as well. Furthermore, the plant has nematicidal properties.
Applying the mixture of 'Marotti' (Jungli-badam /Hydnocar-puspentandra)oil cake and sand in the leaf axils of coconut palm prevents infestation of rhinoceros beetle.	Sand causes cuticular abrasions over the insect body resulting moisture loss and subsequently the toxic principles in 'Marotti' would enter the body and kill the beetle. Further, marotti oil cake repels the beetles, and the sand fills the space to hide thus preventing boring of beetles into the spindle leaf. Sand with any toxic material filled in the leaf axil would prevent the feeding indirectly.

Application of sand and salt in equal proportion in the leaf axilsof coconut during Aug-Sep prevents attack of rhinoceros beetle.	Sand provides a physical barrier and repels the beetles. Further it causes abrasions in the neck of rhinocerous beetle. Salt acts as feeding deterrent. Due to exosmosis caused by salt and physical injury caused by sand the beetles cannot attack the palm, and results in the rupture of skin of the beetles, loss of water and death.
To avoid termite attack, sow the seed nuts by exposing its tip portion above the soil.	The IHP prevents contact of the soft portion/area of attachment with the soil. Thus the sprout/ emerging sprout/tender portion escapes from termite infestation.
Application of leaves of 'Karingotta' (Quassiaindica) and 'kanji-ram' (Strychnosnux-vomica) in coconut basins will reduce the attack of termites.	Both the plants are known to have insecticidal action. Both contain glucosides/alkaloids toxic to termites. Quassia contains Quassinoid alkaloids which are insecticidal where as the toxic principle in Strychnos is the alkaloid, strychnine. So the practice will definitely reduce termite infestation.
Wild arrowroot is planted in coconut garden for preventing /controlling termites.	It has repellent action against termites the tuber exudates of wild arrow root are repulsive, and it repel termites and other soil Fauna.
Coil the trunk of coconut palm with coconut leaves and bamboo thorn to control problems created by rats and thieves.	It acts as mechanical/physical barrier against rodents and thieves. The thieves and rodents cannot climb over these obstacles. But it prevents entry of rats only when the palm is isolated.

Spray fresh cow urine diluted with 10 times of water in the crown to control button shedding.	Cow urine contains certain growth factors like auxins and micro nutrients which prevent button shedding. It contains benzoic acid, oxilisic acid, fuluric acid, phenyl acetic acid, p-oxesol and many other constituents. Thus it provides nutrients and plant growth substances, and prevents drop of buttons.

(Refer: Husain and Sundaramari (2011) for Crop production aspects of coconut; Husain and Sundaramari (2011a) for crop protection aspects of coconut)

Few ITK in arecanut and coffee are given below as a sample for other plantation crops (Husain, 2010)

Avoid planting arecanut during the months of 'Medam' (III week of April to II week of May) and 'Karkkidakam' (July-August)	In 'Karkkidakam', the intensity of South-West monsoon is higher, while sun scorching results if planted in 'Medam'. Hence, planting in these periods is not advisable.
Brushing lime solution or waste oils on the arecanut trunk controls termites.	Waste oil and lime coating on trunk prevents direct contact of termites with bark epithelial tissues of the tree for feeding. Thus the coating acts as a physical barrier. Further, it restricts the movement and run ways on the trunk. Furthermore, lime wash acts as a good termite repellent where as waste oil has pesticidal action.
Select seeds from coffee plants which has easily detachable fruit stalk	One of the problems faced by the coffee farmers is the harvesting of fruits. Some plants have strong fruit stalks attached firmly with the plant, and this makes it difficult for the farmers to harvest the fruits, requiring more labour for the same. If seeds are selected from plants which has easily detachable fruit stalk, this problem can be solved to an extent.

For ploughing the field of coffee, an agricultural tool locally known as 'mullu' is used,	This tool is so designed as to break the small roots of the plant, when dug with, without damaging bigger roots.

Farmer innovations in agriculture

Development of agricultural sector is driven by innovation at all levels. Until recently, little attention was given to the innovation of farmers. Farmers, over the years have developed and fine tuned many innovations which include new technologies, machines and implements, new varieties, crop management practices, and the like.

Farmer innovation in agriculture is the process through which individuals or groups in a given locality discover or develop improved techniques or technology for improved crop production and agricultural resource management. According to the World Bank (2004) local innovation refers to the dynamics of indigenous knowledge, the knowledge that evolves within a social group, incorporating and integrating learning from own experience and external knowledge internalized within the local system. This leads to farmer innovation. It is the problems in crop and animal management that leads to creating improved ways resulting in farmer innovations. Thus crop production problems, pest and disease management problems, agricultural labour problems and the like prompt farmers to innovate. Such innovations will be easily acceptable to other farmers, since it is tested in the real farm situation. Thus farmers' innovations are a product of farmers' informal experimentations. Generally such innovations will be inexpensive, profitable, locally adaptable and sustainable.

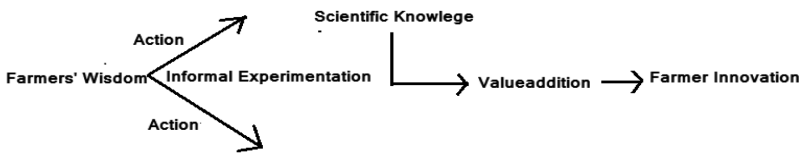


Fig.1. Conceptual frame work of farmer innovation (Prolinnova, 2006)

Some Examples

- New crop varieties by farmers(mainly by selection)

  eg:- Thirumali, a cardamom variety by a farmer (Mr. T.P. Joseph), for which he was awarded nationally (National Grass roots Innovation Award).

- New farm equipments and machineries

  eg:- Mango plucking machine (by Mr. P.P. Gangadharan), Natural fiber extraction machine(by Mr. P.V. Eldo), Tree climber (by Mr. M.J. Joseph) etc.

- New farm techniques and practices

  eg:-A farmer's successful experimentation of pepper (grafted with Collubrinum) cultivation in wet lands (by Mr. Mathai) and similar many innovations

The National Innovation Foundation (NIF) of India (nif.org.in) setup by the Department of Science and Technology (DST) is working to make India innovative by documenting, adding value and protecting the intellectual property rights of the contemporary unaided technological innovations and disseminating their innovations.

Challenges

Though farmer innovations gained importance nowadays, and have high potential, it is constrained by many challenges, which can be summarized as below.

- Lack of research orientation of farmers
- Unfavorable attitude of outsiders including researchers and extensionists
- Lack of financial support
- Lack of peer support

Even against many such challenges, farmer innovations have been happening regularly, but not recognised by other key players in agriculture. But these have to be promoted, and the farmers have to be empowered by giving opportunity to bring in their ideas and skills, and recognizing their innovations.

Conclusion

Various studies revealed that many of the ITK are rational. Similarly, many of the ITKs were perceived effective by the end users (farmers). Such rational and effective ITK may effectively be utilized. Similar is the case of farmer innovations. Unlike modern technologies, such practices generally utilize locally available resources.They do not involve harmful chemicals and are eco-centric. Thus, indigenous practices and farmer innovations need to be promoted for maintaining agricultural sustainability and ecosystem integrity. Hence the time-tested, rational and effective farmer practices suited to the local situations and local culture may be blended with modern crop production technologies, which in turn would promote sustainable crop production.

References

Bandyopadhyay, A. K. and Saha, G. S. 1999.Project on Coping with heat and water shortages on the Andaman and Nicobar Islands. Indigenous Knowledge and Development Monitor, 7(2): 26.

Berkes, F. 1999. Role and significance of tradition in indigenous knowledge. Indigenous Knowledge and Development Monitor,7(1): 19.

Bonny, B. P. 2001. Documentation and validation of indigenous technical knowledge of Kerala. Final Technical Report, Kerala Agricultural University, Thrissur, India, 78p.

Chittiraichelvan, R. and Raman, K. V. 1990.Indigenous knowledge of farmers- its use in extension strategies for rainfed agriculture. In: Technologies for Minimizing Risks in Rainfed Agriculture, Singh, S.P. and Prasad, C. (eds.) Indian Society of Extension Education, New Delhi.

Grenier, L. 1998. Working with Indigenous Knowledge - A Guide for Researchers.International Development Research Centre, Ottawa, Canada, 317p.

Hunter, D. 1996. Traditional pest control and agricultural development in the atolls of the Maldives.Indigenous Knowledge and Development Monitor, 4(3): 10-12.

Husain, A. S. 2010. Knowledge, Adoption and perceived effectiveness

of indigenous horticultural practices in Kerala.Ph. D. thesis, Gandhigram Rural Institute, Gandhigram, India, 274p.

Husain, A. S. and Sundaramari, M. 2011. Scientific rationality and perceived effectiveness of indigenous technical knowledge on coconut (CocosnuciferaL.) cultivation in Kerala. Journal of Tropical Agriculture 49 (1-2) : 78-87.

Husain, A. S. and Sundaramari, M. 2011a. Scientific rationality and evaluative perception on indigenous plant protection practices on coconut (Cocosnucifera L.).Journal of Plantation Crops39 (2): 290-298.

ICAR. 2002. Inventory of Indigenous Technical Knowledge in Agriculture- Document 1. Mission Mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge, Division of Agricultural Extension, Indian Council of Agricultural Research, New Delhi, 411 p.

ICAR.2003a. Inventory of Indigenous Technical Knowledge in Agriculture- Document 2. Mission Mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge, Division of Agricultural Extension, Indian Council of Agricultural Research, New Delhi, 680 p.

ICAR.2003b. Inventory of Indigenous Technical Knowledge in Agriculture- Document 2 (Suppliment1).Mission Mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge, Division of Agricultural Extension, Indian Council of Agricultural Research, New Delhi, 226p.

IIRR.1996. Recording and Using Indigenous Knowledge: A Manual. International Institute of Rural Reconstruction, Silang, Cavite, Philippines. 211p.

Kumar, A. 2007. Traditional plant protection management practices of Rajasthan. LEISA INDIA, 9(4): 29-30.

Mane, P. M. 1990.Study of traditional agricultural practices.Honey bee, 3(1): 3.

Narsinhbhai, V. R. 1993. Enhancing germination.Honey bee, 4(1): 11.

National Research Council. 1992. Conserving Bio-diversity: A Research

Agenda for Development. National Academy Press. Washington, D. C., USA.

Prakash, T. N. 1999. For curing nose rope wound. Honey bee, 10 (4): 9.

Prakash, T. N. 2000. Compost from coir pith and bonus of weed control. Honey bee, 11(2): 10.

Prolinnova. 2006. Prolinnova-Ethiopia Progress Report. Annual Report, Leusden, Prolinnova Secretariat.

Purushothaman, C. 2003. An analysis of indigenous farming practices of horticultural crops in Villupuram district o Tamil Nadu. M.Sc. (Ag.) thesis, Annamalai University, Annamalainagar, Tamil Nadu, India.

Rajagopalan, C.R. 2003. Indigenous knowledge/CFS experience. Indian Journal of Traditional Knowledge, 2 (4):.313-320.

Rambabu, P. 1997. Indigenous technologies in cropping systems- an analytical study in Guntur district of Andhra Pradesh. Ph.D. thesis, Acharya N. G. Ranga Agricultural University, Hyderabad, India.

Seeland. K. 2000. What is indigenous knowledge and why does it matter today. In: Man in the Forest, Seeland, K. and Franz, S. (eds.), Pintworld, New Delhi, 775p.

Sikhana, P. 1994. Alternatives to Current Agricultural Research and Extension System. Intermediate Technology Publication Ltd., London, 374p.

Singh, A. K. 2007. Indigenous water management system by the farmers of north eastern hill region. LEISA INDIA, 9(1): 15

Somasundaram, S. 1995. Indigenous knowledge in farming systems. Ph.D. thesis, Tamil Nadu Agricultural University, Coimbatore, India.

Sonomou, O. E. 2008. Red ants (Oecophyllalonginoda) control in coffee plantations. Honey bee, 19(1): 18-19.

Sreekumar, K.M., Thamban, C. and Govindan. M. 2006. Indigenous Knowledge of Farming in North Malabar. Centre for Environment Education, Ahmedabad, India and Foundation Books Pvt. Ltd.

New Delhi. 157p.

Sundaramari, M. 2001. Adoption and perceived effectiveness of indigenous agricultural practices in different farming systems. Ph. D. thesis, Gandhigram Rural Institute, Gandhigram, India.

Sundaramari, M., Ganesh, S., Kannan G. S. and. Gopalsamy, K. 2008a. Rationality and adoption of indigenous agricultural practices on sorghum (Sorghum bicolor) cultivation. Paper presented at the National Conference on 'Traditional Knowledge Systems, IPR and their Relevance for Sustainable Development', 24 -26 November, 2008, NISCAIR, Pusa, New Delhi.

Swapna, T. R. 2003. Rationalisation of ITK on pest management in the farm production systems of Palakkad district.M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, India.

World Bank. 1998. Indigenous knowledge for development- A framework for action. Knowledge and learning center, Africa region.

World Bank. 2004. Promoting local innovation: enhancing IK dynamics and links with scientific knowledge. IK Notes 17 (http://www.worldbank.org/afri/ik/default.htm).

Innovative extension approaches for plantation crops (2016) : 191-204
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Participatory technology development and transfer: Experiences in cashew

Sajeev, M.V.

Introduction

Cashew (*Anacardium occidentale* L.) a native crop of Brazil was introduced into India by Portuguese travellers in 16th Century for the purpose of afforestation and soil conservation. In the early part of 20th century, India was the first country to develop technology for extraction of cashew kernels from raw cashewnuts and even today benefits from the export potential of the kernels. Cashew has adapted well in India and is grown along the coastal regions of Maharashtra, Goa, Karnataka and Kerala in the West Coast and Tamil Nadu, Andhra Pradesh, Odisha and West Bengal in the East Coast. It is spreading in non-traditional areas such as Bastar region of Chhattisgarh and Plain regions of Karnataka, Gujarat, Jharkhand and North Eastern Hilly (NEH) regions. This is a remunerative crop and even with little care a net income of about 50,000/ha can be realized on less fertile land, where other economic crops does not perform. The net income can be considerably enhanced with the participatory transfer of newly released varieties having high yield potential and improved and intensive crop management practices.

Technology Development

Technology Development (also called technology innovation) is a process consisting of all the decision and activities which a scientist does from recognition of a need/ problem with planning, testing, conducting research, verification, testing and dissemination for adoption. During the same time, some problems on the technology might get back to

the scientist for solution thus resulting in refinement of the same. Thus, technology development is a continuous process. Extension workers act as a crucial player in testing, adaptation and integration of proven technologies. They have to equip themselves for 'technology application' - a process which includes the above mentioned processes; thus contributing their part in the overall process of technology development.

Understanding technology development process

Understanding technology development process in agriculture and its components is vital for success of extension workers. Technology development basically constitutes seven processes. They are:

1. Technology generation
2. Technology testing
3. Technology adaptation
4. Technology integration
5. Technology demonstration
6. Technology dissemination
7. Technology adoption

Technology Assessment and Refinement (OFT)

Frontline Demonstration (FLD)

Technology generation, the starting point of technology development process is mainly a function of research system. Testing, adaptation and integration processes constitute technology assessment and refinement which SAUs/ICAR system executes through On Farm Trials. The feedback is passed over to research system. This system also involves in technology demonstration through FLDs. Feed-forward from successful OFTs and FLDs is communicated to the extension system for mass popularization in the district. Technology adoption; the final act, occurs among the members of client system i.e. farmers.

Technology Management

Technology management can be defined as the integrated planning, design, optimization, operation and control of technological products, processes and services. A better definition would be "the management of the use of any technology for farmer advantage." The extension role

under technology management is very huge where-in it selects latest technologies, tests them for suitability in different micro-locations and demonstrates the proven ones to farmers.

Technology fatigue

Linkages between the laboratory and farmer fields have weakened and extension services often have little to extend by way of specific information and advice on the basis of location, time and farming system. Good quality seeds at affordable prices are in short supply and spurious pesticides and biofertilizers are being sold in the absence of effective quality control systems. Farmers have no way of getting proactive advice on land use, based on meteorological and marketing factors. No wonder the prevailing gap between potential and actual yields, even with technologies currently available, is very wide. A knowledge deficit as mentioned above coupled with the usage of obsolete technologies and package of practices together leads to a situation called 'technology fatigue'. Indian agriculture, particularly agriculture by resource poor farmers in rural areas is now bearing the brunt of technology fatigue. The extension role lies in providing timely supply of proven technologies specific to various micro-locations of the district thus alleviating the technology fatigue existing in the area. In this context, farmer participatory technology development assumes utmost importance.

Participatory Technology Development (PTD)

Participatory Technology Development (PTD) can be defined as an approach that links participatory research with extension that bases on the promotion of internal capacity of rural communities to find out innovations in agriculture and natural resources management which meet the desires of farmers and suit strengths and weaknesses of households and communities.

PTD can be understood as a participatory approach in which farmers, researchers and extensionists cooperate to experiment innovative technologies that suit farmers' conditions. Farmers play a vital role in PTD, while the researchers support technically to the farmers' experiments. The extension worker's role is to facilitate the experiment

process and the interaction between farmers and researchers. In PTD we try to find out "new things" which suit farmers and communities' conditions. The new things include technical novelties, new ways of organization or new system of management or new in application conditions.

PTD process consists of participatory activities together with farmers to identify and select ideas, and try them out in the field and forests. Researchers and extensionists collaborate in steps including PTD initiation, implementation, monitoring and evaluation of PTD based on needs and conditions of farmers. It meets expectation of farmers while considering feasibility, practicality and conditions of farmers to select appropriate solutions. Therefore, they are either not technical solutions that are over capacity of villages nor technologies transferred from outside that do not meet needs of farmers. In PTD, knowledge of farmers, researchers and extensionists is equally considered. Farmers are an equal partner in development and application of new technologies which are appropriate for agricultural and forestry production. Regarding the collaboration and learning process of different actors, PTD can be understood as a cooperative process of combining local knowledge and scientific knowledge, in which local knowledge is considered as important as any of scientific knowledge. PTD stimulates this creative combination to mobilize internal resources of farmers in order improve production and natural resources management in rural areas.

Participatory Technology Development in cashew: A background

To provide technology backstopping to farmers on frontline cashew production technologies developed by Directorate of Cashew Research and other cashew research stations, cashew demonstration plots based on Farmer Participatory Technology Development (PTD) model were laid out at selected farmers' plots. These PTD cashew gardens serve as demonstration plots to prove the effectiveness of the recommended cashew cultivation practices to farmers while for scientists, these demonstration plots are the tools for assessment and refinement of the recommended practices based on the performance of technologies at

micro location level. Laying out of farmer participatory demonstration plots started from the year 1988 as part of the research project; "Transfer of Technology Programmes in Cashew" with the following objectives:

i. To provide technology backstopping on frontline cashew production technologies.

ii. To assess, refine and demonstrate the frontline cashew production technologies.

This research project is externally funded by Directorate of Cashew nut and Cocoa Development, Cochin. Under this programme, every year interested farmers are being selected for demonstrating the frontline cashew production technologies. The newly selected demonstration farmers are provided with subsidy and are being trained every year at DCR, Puttur on Cashew Production Technology.

The farmer participatory technology demonstration gardens are regularly visited by the project team and other scientists. The conditions of these plots are assessed based on the criteria viz., removal of forest trees, gap filling, initial training, pruning, soil and water conservation practices, application of manures and fertilizers and plant protection measures. Technical advice is being given to the demonstration farmers based on conditions of the plots.

So far in Dakshina Kannada district a total of 162 model cashew demonstration gardens were laid out. Among the five taluks of the districts, in Puttur taluk more number of plots were laid out and 78 plots were under normal density system whereas remaining 84 plots were under high density planting system. The varieties/types which were distributed as planting material are Bhaskara, VRI-1, VRI-2; Ullal-1, Ullal-3; H-3-13; VTH 174; BLA 139-1; H-3-17; BPP-3; VTH 59/2; VTH 30/4; T.No.40; Selection-1, 2; Goa 11/6; H 32/4; V-4; NDR-2-1 and Ullal-4. Presently 91 participatory FLD plots are taken up in tribal farmer plots under Tribal Sub Plan scheme. The technologies demonstrated include recommended varieties and planting densities.

Steps in conducting PTDs with relation to Cashew

1. Diagnosis

The diagnosis involves collection and analysis of information by concerned extension worker to design a PTD. In this step, a study of cashew farmers' circumstances and practices are made in order to

- Understand the farming system prevailing in the area and system interactions.
- Identify existing/possible productivity problems.
- Begin to develop hypothesis on possible solutions.

Farmers' circumstances include

a. Agro-climatic circumstances

- Climate and weather conditions
- Soil and topography
- Pests, weeds, diseases etc.

b. Socio-economic factors

- Institution (Credit)
- Markets (Inputs and Products)
- Income and Land holding
- Farmers' own resources (Family labour) etc.

We identify the farming systems/ system interactions through the following sources/methods:

- Secondary data/ sources
- PRA methods to be exercised in collaboration with local people.
- Interview with local officials/ opinion leaders
- Informal farm surveys
- Farmers' interview using structured/ semi-structured schedules
- Field observations

2. Planning

The planning step in a PTD includes listing of problems, ranking

problems in terms of severity, importance and frequency and identifies causes of problems and list possible solutions to well defined problems and screen possible solutions for feasibility.

While identifying the solutions from PTD, one should note that the technology should have profitability and compatibility with the existing farming systems, reduces risk, and ease of testing for cashew farmers. The assessment of trials is made based on agronomic sense of trial results, statistical significance, economic analysis, and ability to solve the problem-cause and solution developed during diagnosis. The results of trial are extrapolated for defined groups of farmers in specific micro-locations. Planning involves:

- Listing problems
- Ranking Problems
- Identifying causes of problems
- Listing possible solutions

Problems should be ranked so that higher priority problems can be clearly distinguished from lower priority problems. We should aim to focus on those problems which, if solved, would lead to a significant benefit to farmers.

Prioritization/ranking is done with scores based on the following criteria

- Problems that cause a large productivity loss/
- A new technology that brings high productivity
- Problems that occur frequently
- Problems that affects majority farmers

Identifying the causes of problems

If the causes of a problem are not understood properly, one may waste time and resources on inappropriate solutions. Understanding the root causes of a particular problem would help to get proper solutions which could make timely detection and correction of defects.

Listing possible solutions

Scientists have to list possible solutions to well defined problems,

whose causes are fairly well understood. At this stage, list any possible solution that seems to fit. The least feasible ones are later screened out. Solutions are based on

- Probability that the technology will function
- Profitability of the technology
- Compatibility with the existing farming situation/ systems
- Contribution to reducing risks
- Ease of testing for farmers

3. Conducting

PTDs are conducted in the fields of representative farmers and to evaluate the selected small numbers of experimental variables in participation with the local people/ farmers. While conducting PTDs, we can

- Explore production problems
- Test possible solutions
- Verify recommendations
- Demonstrate them with farmers

4. Assessment

- The results of PTDs are analyzed carefully. The analysis require assessment of
- Farmers' reactions and opinions
- Agronomic interpretation/ feasibility
- Statistical significance
- Economic analysis/ profitability

Ability to solve the problems - cause and solution developed during diagnosis.

The technological attributes which are considered while assessing the results in PTDs compared to the existing local ones are, Profitability, Risks, Relative costs, Simplicity, Sustainability, Farmers safety and Farming system compatibility.

5. Extrapolation/Dissemination

When we are convinced and satisfied with the results/outcome out

of PTDs, the implementing agency formulates recommendations for demonstrations (FLD) on a larger area in the farmers' fields so as to popularize the technology amongst farming communities and to give feed-forward to extension system. The implementing agency ensure that

- Extension agents participate in the trial and demonstration process (to transfer recommendations to farmers with skills and confidence)
- Farmers involvement in the demonstration process (to participate effectively in the diffusion of new technologies)

When are PTDs needed?

PTDs are needed when one or more of the following situations exist in the area.

- When practices recommended by the research stations and extension system are not being followed;
- When practices recommended by the research stations and extension system are being followed, but yields/results remain low;
- When a district has locations that has special attributes which do not fit the general pattern. Ex: the location may be hilly, steep-sided valleys, rocky surfaces, perhaps with wetter or more saline soil; and
- When particular microlocations are less productive than neighbouring ones in same/neighbouring districts despite best efforts by farmers.

Benefits of PTD

- There are various benefits of conducting PTDs.
- The PTD may show how to increase economic returns by a changed practice that increases yield.
- The PTD may show how to reduce costs by reducing the use of fertilizer, machinery, labour or water without loss in yield;
- In the long-term there may be indirect benefits of any changed technology that improves sustainability;

- Unexpected positive things may be discovered about the farm because the farmer has been thinking about it differently and observing it more closely and critically;
- There is close interaction between the extension worker and the farming community as they work together. The farmer learns trial methods and concepts from the EW and the EW learns more about the local cropping systems and about limitations other than the technological ones;
- Fellow farmers will be interested in the PTD, will be doubtless and also give their opinions, may even join in and will be the first to adopt and then adapt the refined technology if it works.

Some problems in conduct of PTDs

Associated with the benefits explained above, there may be the possibility of various problems in conduct of PTDs.

- The land will be out of normal use during the PTD, so normal production from farm may not be achieved. Including the trial as part of the farm's normal cropping pattern and keeping the trial small and manageable can minimize this cost and make farmers' accept PTDs to be conducted on their farm;
- The yield from the trial could be appreciably lower than normal yield, even perhaps a total loss. We should foresee whether the farmer in question can afford that risk or not;
- Extra inputs will be a cost, items like fertilizers, labour, machinery and perhaps most importantly, time and
- There may be a personal and social cost of possible failure on the farmer i.e. the family and friends. Expectations of the PTD should be moderate, not exaggerated. It is always better for us to undersell expectations.

Selecting collaborating farmers

Thorough discussions have to be made with the collaborating farmers before start of PTD. The purpose of PTD has to be made clear to the farmer without any scope for doubt. Try to select farmers who have risk bearing ability. Also, the collaborating farmer should have good rapport

with other farmers. This will help free interaction of the neighbouring farmers with him thus spreading the message. Also try to avoid 'people biases' wherein we tend to select an influential farmer with lot of land and resources under him. It is easy to conduct PTD under such influential farmers. But, many a times this prevents other interested farmers from interacting with the elite farmer and extension worker.

Understanding farming efficiency of collaborating farmer

The efficiency with which the farmer previously managed his crop growth activities is also an indicator to the success of present PTD. Some questions for which answers have to be found include:

- Are fertilizers and irrigation, where available, being applied at the most beneficial time for the crop and are they used efficiently in his/her field?
- Are pests, diseases and weeds being controlled at the right time and effectively? Could the outcome of present trial be achieved by using less effort or fewer chemicals in smaller amounts?
- Is machinery available when needed?

Finding out which, and to what extent, these environmental, crop variety and management factors have an impact on the best use of the growing season is the first reason for above questions regarding farmer field.

The second reason for such questions is to test ideas to overcome the constraints to production that have been already identified. Debating the above mentioned questions will improve knowledge of the extension worker and the farmers' awareness of local limitations. Design PTD by including possible solutions as treatments. It may take several meetings before the PTD is finalized to the satisfaction of all actors involved but it can be a highly profitable utilization of time for both extension worker and the concerned farmers. Throughout, encourage the free-flow of ideas from farmers.

Selecting technologies for PTDs

The implementing organisation should take utmost care in selecting plant varieties for PTDs. If the PTD is planned as a simple varietal

assessment and development then, it should be made sure that the variety is newly released. We should always try to assess and refine latest technologies so as to prevent and alleviate technology fatigue in the locality. An old variety or technology will become part of an PTD only if the trial is meant for anything else than varietal trial. If the trial includes comparing varieties, discuss with the farmer which new variety to include and why. Talk about their pest and disease resistance, lodging tolerance including propensity for tillering, fertilizer and water requirements, and quality and yield.

The same applies in testing of other material technologies. Highly successful pesticides, agricultural implements, hybrid seeds etc which are already cultivated by farmers of the district should be never taken up for PTDs. Some institutions are even found to have attempted to assess and refine management practices of various local varieties. They should find a more remunerative technological option than assessing and refining local varieties. It should be also noted that the B:C ratio of any assessed technology should be far superior to that of farmer practice so as to advocate the same to them in future. A marginal increase in incomes is not worth advocating as far as replacing ruling technologies are concerned.

Analyzing and discussing PTD results

Conducting PTD is meant for the improvement of the existing production practices and farming systems at large. Consider conducting follow-up study with an on-farm field day to involve other local farmers in the results. Encourage them to air their views on the weaknesses and strengths of the technology tested and developed and to suggest ideas for future collaborative PTDs.

Publishing PTD results

Most organizations retain PTD results with them without proper publicity. At the most, these results get published in the annual reports. The scientists and extension workers are afraid that results from on-farm trials may not be acceptable to scientific journals because of statistical considerations. But properly planned and conducted PTDs will have supporting data recorded by the concerned extension

worker and farmer. In the interest of the large scientific community, utmost efforts are to be made to publish PTD results. This will also help to prevent duplication of trials in similar microlocations or can also facilitate similar trials on same technology in other parts of the country. The results should also go as popular articles in local language newspapers and magazines thus spreading the timely message leading to alleviation of technology fatigue.

Conclusion

Retaining interest of new generation cashew farmers and attracting more of them towards cashew farming is a big challenge. Better utilization of advances in social capital research has to be made towards social mobilization for formation of cashew farmer groups aiding in participatory transfer of latest cashew production technologies. Identification of sustainable cashew based farming systems through extension research will prove to be beneficial towards planning meaningful outreach activities for overall improvement of cashew farmer livelihoods. More emphasis has to be given for extension research and the knowledge about technology fatigue has to be made available in the coming years. This, along with advances in participatory technology development has to be used towards successful technology backstopping in the future.

References

Swanson, B. E. 1997. Changing Paradigms in Technology Assessment and Transfer; Unpublished paper. Urbana, IL: University of Illinois, INTERPAKS.

Venkatasubramanian, V., Sajeev M.V. and A.K. Singha. 2010. Concepts, Approaches and Methodologies for Technology Application and Transfer – A resource book for KVKs, Second Edition. Zonal Project Directorate, Zone – III.

Sajeev. M.V. & V. Venkatasubramanian. 2010. Technology Application through Krishi Vigyan Kendras: Conceptual Paradigm, International Journal of Extension Education, INSEE, Nagpur. Vol.6:45-54.

M.G. Nayak and Sajeev M.V. 2011. Achievements of DCR in Transfer

of Technology of Cashew, In: Silver Jubilee Celebrations (1986-2011), National Expert Consultation on Cashew, Souvenir 2011, DCR Puttur. 'pp: 31-34.

Sajeev M.V. and C. Thamban. 2015. Farming System Research/ Extension approach for technology transfer in plantation crops, In: Training Manual, Participatory Technology Transfer Approaches for Plantation Crops, ICAR-CPCRI, Kasaragode, pp: 204-217.

Innovative extension approaches for plantation crops (2016) : 205-222
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Participatory technology transfer - Success story of arecanut based cropping system

Jaganathan, D., Nagaraja, N.R., Jose, C.T. and Rajkumar

Introduction

Arecanut (*Areca catechu* L.) is one of the important commercial crops grown in parts of Karnataka, Kerala, Assam, Meghalaya, West Bengal and Andaman & Nicobar Islands. Arecanut is cultivated in an area of 453 thousand ha with an annual production of 632 thousand tones in India. Karnataka, Kerala and Assam are the major producers (Table 1). Suitable agro-techniques for arecanut and economically feasible cropping systems were developed as an answer to the recurring problems faced by the arecanut farmers such as high investment, weather aberrations, price fluctuations and pest and disease problems. Efficient recycling of organic wastes from arecanut plantation through vermicomposting has been standardized to supplement the chemical fertilizers.

Table 1. Area under arecanut in India

State	Area ('000 ha)	% share	Production ('000 t)	% share	Yield (kg/ha)
Karnataka	221.4	49	358.6	57	1620
Kerala	101.7	22	118.2	19	1162
Assam	75.1	17	72.6	11	967
West Bengal	11.4	2	21.2	3	1857
Meghalaya	16.0	4	23.0	3	1626
Others	28.0	6	39.0	6	---
India	453.6		632.6		1395

Source: NHB, 2014-15

Long pre bearing period, fluctuations in market prices, unexpected loss due to adverse environmental conditions, pests and diseases etc. are some of the major problems in arecanut cultivation (Bavappa *et al.*, 1986) which have generated livelihood concerns of arecanut farmers in India. A check in additional area expansion and encouraging the farmer to adopt arecanut based cropping systems by strengthening the Transfer of Technology (ToT) activities would certainly benefit the arecanut farmers in the long run. Different agencies viz., Central Plantation Crops Research Institute (CPCRI), State Agricultural Universities (SAUs), Directorate of Arecanut and Spices Development (DASD), Central Arecanut & Cocoa Marketing & Processing Cooperative Ltd. (CAMPCO), Department of Horticulture, Farmers Organizations and Self Help Groups (SHG's) are doing research and extension activities for arecanut development. Technologies related to improved varieties, nutrient management, pest and disease management and post harvest processing have been released by research institutes for increasing the productivity and profitability. ICAR- CPCRI has a history of about 60 years of arecanut research with high yielding varieties, package of practices, post harvest technologies and research findings. The demand for CPCRI technologies like high yielding varieties/hybrids of arecanut, vermicomposting using arecanut and cocoa wastes, integrated nutrient management with judicial, balanced and split application of organic and inorganic fertilizers, natural enemies/ predators in areca-cocoa ecosystem and bio-control agents and Integrated pests and diseases management practices for arecanut has been very high among the farming community and other clientele. Research and extension activities are changed as per the demands of clients viz., farmers, agricultural/ horticultural officers, agro processors, Self Help Groups, college/school students etc. Assessment and refinement of technologies is done through co-operation of Developmental Departments/Boards by organizing various programmes with the active participation of farmers. CPCRI has been doing front line extension programmes for the benefit of the stakeholders.

Several studies reported that Arecanut Based Multispecies Cropping System (ABMSCS) is effective for increasing the production per unit area and maximizing the economic returns through better utilization

of natural resources. In order to follow this cropping system, farmers need to be convinced about the socio- economic and technical feasibility in their local conditions. ICAR - Central Plantation Crops Research Institute (CPCRI), Directorate of Arecanut and Spices Development (DASD), State Agricultural Universities (SAUs), Krishi Vigyan Kendra (KVK), Department of Horticulture and other organizations have been promoting the concept of arecanut based multispecies cropping system to increase the productivity and profitability of farming from unit area. Success story of participatory technology transfer (PTT) in arecanut based cropping system is described below.

Concept of Participatory Technology Transfer (PTT)

Participatory technology transfer is a process of bringing together the local communities with their own knowledge and capacity for extension on one platform with the researchers, extension workers and other professionals (Hagmann *et al.*, 1998).

Participatory Technology Transfer (PTT) is one of the established methods for ensuring effective people's participation in transferring technologies. PTT is a process of purposeful and creative interaction between local farming groups and the change agency for transferring acceptable and affordable technologies. It is a process of building up farmers' capacity to identify, innovate, test and evaluate the intended technologies enabling them to adopt the technologies in large area.

PTT approaches are based on effective participation of rural communities. The focus of PTT is to promote greater involvement of farmers in planning and implementing technologies. Farmers are encouraged to take initiative and work with extension staff on equal terms, for testing and implementing technologies. Capacity building, social mobilization, experiential learning and empowerment are major elements of PTT.

The comparison of conventional ToT model with PTT model is given in Table 2 for better understanding of the two approaches (Scoones & Thompson 1994). The focus of extension changes from teaching to learning; from hierarchical, top-down to participatory bottom-up approaches; from centralized to decentralized decision making.

Table 2. Conventional TOT model versus Participatory Technology Transfer model

Feature	**Transfer of Technology (ToT)**	**Participatory technology transfer (PTT)**
Main objective	Transfer technology	Empowerment of farmers
Analysis of needs and priorities set by	Outsiders (extension agents, researchers)	Farmers facilitated by outsiders
Primary R&D location	Research station	Farmers' fields and conditions
Menu of technologies	Fixed (blanket recommendations)	Baskets of options (flexible recommendations)
Dissemination process	Linear transfer of precepts, messages and technological packages	Dynamic process based on joint analysis and farmers' choices
Farmers behaviour	Taught about the message: adopt or reject	Use methods, choose from basket and experiment
Outsiders desired outcome	Widespread adoption	Wider choice for farmers and enhanced adaptability
Main mode of diffusion	Extension workers to farmers	Farmer to farmer
Role of extension agent	Provider of information, technical supervisor, teacher	Facilitator, catalyst, advisor

Steps in Participatory Technology Transfer (PTT)

Steps in Participatory technology transfer as reported by Havecort *et al.*, 1991 is given below.

Six basic steps in PTT process

- Getting started
- Understanding problems and opportunities
- Looking for things to try
- Experimentation
- Sharing the results
- Keeping up the process

Step 1: Getting started

Purpose: It is a familiarization process. This includes how PTT practitioners from outside the community choose an area, introduce themselves, build up a good relationship with the local people, analyze the existing agricultural situation and form a basis for cooperation with network of farmers to start the process of technology transfer. This includes widening of all involved about the sociological, socio economic, cultural and political dimensions of the current situation.

Process: Village selection. Building up rapport with the local communities. Gather and analyze data on the existing agricultural situation. Build contacts with necessary people in the village, like village leaders, school teachers, local institution heads, local experiment station staff etc. Identify group of farmers willing to participate in the PTT process.

Suggested methods: Individual and group contacts. Group meetings / discussions. PRA / RRA. Community walks. Community led surveys. Analyzing secondary data.

Expected outcome: A basic understanding of the socio-cultural and agro ecological situation in the selected villages. A clear perspective on the cooperation between the local communities and the PTT team. A core network of persons, groups and organizations that can play a role in strengthening and sustaining the local experimenting capacity. A group of farmers willing to conduct PTT identified.

Step 2: Setting up a goal/objective

Purpose: The purpose is to enable farmers to identify and prioritize problems, analyze information, identify options for dealing with the

problems and develop an agenda for PTT.

Process: Identifying crop related problems by farmers. Prioritizing problems by farmers. Screening local knowledge and past experimentation for likely options for further testing or for unresolved problems. Gathering promising ideas from outside the villages. Reaching consensus on the plan of action for conducting PTT. (selecting priority problem, developing selection criteria and screening options etc.)

Suggested methods: Farmer workshops. Innovator workshops. Key informant group interviews. Focus groups. Diagrammatic representation of: - case histories - preference ranking -inventory of farmers indicators -study tours. Preference ranking to understand farmers priorities. Study tours to gather ideas from other farms.

Expected outcome: An accepted agenda for PTT. Improvement in farmers skills in analyzing problems and looking for options. Increased social awareness and self confidence. PTT groups established. An improved organizational basis for conducting systematic local trials.

Step 3: Designing experiments

Purpose: To develop trials that suit farmers' purposes and to strengthen their capacity (skills, organization and self confidence) in designing trials independently. The idea is to improve, reinforce and add to farmers' experimental practice.

Process: Reviewing farmers trials in the past (what do they try out/ how do they do it/ why do they do it etc) Planning and designing the selected trials (who/size of plots/control plots/criteria for location selection/treatment plans/layout trials/inputs required etc.) Developing protocols for evaluating trials (criteria for evaluation/who will do recording observations/monitoring, when, how etc)

Suggested methods: Farmers workshops Farmer to farmer training Testing alternate options

Expected outcome: Experimental designs that are reliable, evaluable and manageable by farmers. Improved skills of farmers to design trials. Monitoring and evaluation systems in place.

Step 4: Trying things out

Purpose: To carry out, measure and assess the trials and build up farmers testing skills, strengthening their capacities to conduct and monitor trials.

Process: Actual implementation of the trials designed. Learning the skills required for conducting trials. Exchanges and linkage building with other communities and organizations.

Suggested methods: Step wise implementation. Regular group meetings. Field days/Exchange visits. Strengthening supportive linkages.

Expected outcome: A growing number of experiments, with technologies relevant to local situations, are implemented and evaluated systematically. Development of PTT network, within and between villages. Institutional linkages are built. The practical skills of involved groups of farmers to implement and evaluate experiments systematically are strengthened. Growing active support of outside organizations and institutions.

Step 5: Sharing the results

Purpose: The main aim is to diffuse promising options to try with as well as ideas and experiences about how to conduct trials i.e., innovative concepts, skills forms of organization.

Suggested methods: Farmer to farmer training individual level and group level (formal/informal training) Farmers meet Field days and stakeholder workshops Visit to sites where PTD is conducted Preparation and dissemination through products like manuals, audio-visuals etc.

Expected outcome: Enhanced farmer to farmer diffusion of ideas and technologies. An increasing number of villages involve themselves in processes of organized technology development, making use of the experiences of other communities. A farmer-managed system of inter-village training and communication.

Step 6: Keeping up the process

Purpose: After the trial process, to leave the communities with the

ongoing capacity to implement effective and reliable PTT processes.

Process: Assisting PTT groups to consolidate. Strengthening consolidation of inter-village cooperation, eg., by stimulating linking up with existing, or developing new farmer's organizations at area level. Consolidating the institutional support for local PTT processes by promoting farmers participation in formal research/ extension programmes, providing training possibilities for staff of those institutions, promoting policy level support to PTT in area-development strategies and institutional mandates. Developing local systems for monitoring the trials and diffusion process and its impact on the agro-ecological system and the livelihood of the communities involved.

Suggested methods : Regular group meetings, networking and building linkages with the formal research institutions. Documentation/ developing resource material. Developing linkages between PTT groups and mass media like radio, news papers etc. Monitoring impacts.

Expected outcome: Consolidated community networks/organizations for agricultural self management and a more supportive institutional environment. Documented and operationalized. PTT approach and resource materials. Ensured relevant services and input supply.

Advantages of PTT

- Consultation and access to information for the local people about the intentions of outsiders
- Freedom of choice for local people to engage in a process of technology transfer.
- Empowerment through redistribution of power on the basis of equity and compatibility.
- Mutual trust and respect
- Distribution of benefits to partners equally.
- Adaptability and flexibility of outside institutions to changing and sometimes unforeseen circumstances.
- It strengthens the link between indigenous and scientific knowledge
- It builds human capacity for self reliance

- Disadvantages of PTT
- Demands patience
- PTT approach takes a long time
- Humility on the part of the outsiders

PTT in arecanut based cropping system

Scientific study on arecanut based cropping system was initiated during 1970s at CPCRI. Arecanut based multispecies cropping system is effective for increasing the production per unit area and maximizing the economic returns through better utilization of natural resources. Due to various constraints, many arecanut growers are not able to adopt the multispecies cropping system to the desired level. Survey on adoption of cropping system revealed that crop combinations like arecanut + banana were adopted by 36 per cent of farmers followed by arecanut + banana + black pepper (27 %) and arecanut + cocoa (11 %) (Jayasekhar *et al.*, 2012). Similarly, arecanut + cocoa + banana + black pepper were adopted by 33 per cent of farmers in Puttur taluk of Dakshina Kannada (Jaganathan and Nagaraja, 2015). Establishing participatory demonstration plots in farmer's gardens will encourage many others to follow arecanut based multispecies cropping system for the improvement of their livelihood. In order to follow this cropping system, farmers need to be convinced about the socio- economic feasibility of technology in their local conditions. Farmers' involvement in technology transfer is highly indispensable in the context of participatory regime. Establishing demonstration plots through Participatory Technology Transfer (PTT) in farmer's gardens will encourage many others to follow arecanut based multispecies cropping system for the improvement of their livelihood. Keeping this in view, ten participatory demonstration plots on arecanut based cropping system sponsored by Directorate of Arecanut and Spices Development, Ministry of Agriculture and Farmers' Welfare, Kozhikode were established in Puttur taluk (4 nos.), Belthangady taluk (3 nos.) Kasaragod taluk (3 nos.) during 2012 for enhancing productivity and profitability of farming per unit area.

Partners in PTT: Participatory technology transfer in arecanut

based multispecies cropping system involves the following partners in achieving the stable, sustainable and productive technology transfer of technologies. The conceptual framework of the PTT in arecanut based multispecies cropping system is given in Fig 1.

- Arecanut growers
- Scientists of CPCRI, Regional Station, Vittal
- Directorate of Arecanut and Spices Development, Calicut
- Department of Horticulture- Karnataka & Kerala
- Krishi Vigyan Kendra, Mangalore and Kasaragod
- Media – Press, Journals and Vide

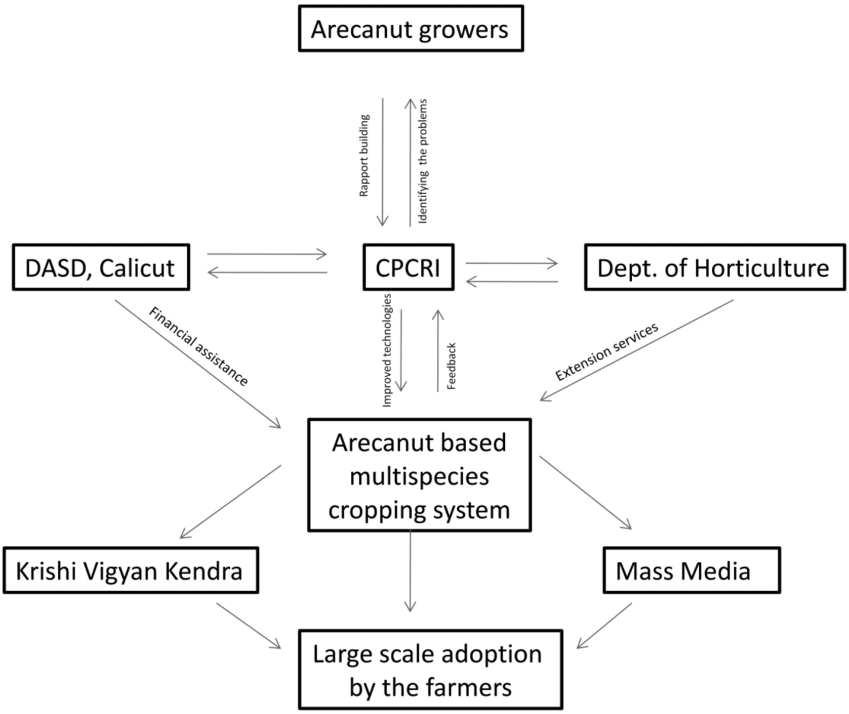


Fig. 1. Conceptual framework of PTT in arecanut based cropping system

Selection of beneficiaries: Farmers who had interest in taking up intercrops were selected after following the principles of participatory demonstration. Socio–economic background, available resources,

farming details, farming practices, knowledge on cropping system, yield details, constraints in farming etc. were collected in detail with the active participation of the farmers. Ten arecanut gardens of one ha area aged 15 years were selected for establishing demonstration plots on 'arecanut based multispecies cropping system' with banana, cocoa and black pepper as component crops. Planting materials were supplied and expenditures for planting and organic inputs were provided through funding from DASD. The planting system followed is given below.

Crop	Spacing (m x m)	Population/ ha	Method of planting	Varieties
Arecanut	2.7 x 2.7	1370	Square	South Kananra local/ Mangala/ Mohitnagar
Banana	2.7 x 5.4	685	Centre of 4 palms	Kadali, Nendran
Cocoa	2.7 x 5.4	685	Centre of 4 palms	CPCRI F1 hybrids
Black Pepper	2.7 x 5.4	1370 (2 vines/ palm)	Trail on palms	Panniyur- 5

Capacity building and providing resources: Team of scientists from CPCRI consisting of different disciplines selected the beneficiaries based on the scoring criteria. Medium growing banana viz., Kadali and nendran was introduced which gave big bunches with more number of fingers. Elite cocoa hybrid seedlings were supplied for early and high bearing. Panniyur- 5, a shade tolerant and high yielding pepper variety was introduced. Inputs were supplied to the farmers during first three years for establishing demonstration plot. Farmers' were trained on latest technologies with respect to arecanut, banana, cocoa and black pepper. Frequent farm advisory visits were carried out by the scientists of CPCRI to monitor the growth and yield performance of main crop and intercrops.

Growth and yield performance of main crop and intercrops

Arecanut: Intercrops such as banana, cocoa and black pepper was

introduced in 2012. Mean yield and income details from arecanut are given below. The data clearly indicates that arecanut yield will not be reduced by introducing intercrops (Jaganathan *et al.*, 2013). During 2015-16, the mean yield of arecanut was 2550 kg/ha and gross income was Rs. 652800 (Table 3).

Table 3. Yield and returns of arecanut

Particulars	**Year of observation**				
	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**
Mean dry kernel yield (Kg/ha)	2135	2345	1950	2321	2550
Price (Rs./Kg)	159	175	178	248	256
Gross Income (Rs./ha)	339465	410375	347100	575608	652800

Yield and returns of banana

Banana was planted in the centre of four areca palms. Yield and income details are given below (Table 4). Additional income realized from banana was Rs.106663. Banana wastes were recycled/ reused as mulch in the garden for increasing the soil fertility.

Table 4. Yield and returns of banana

P articulars	**Year of observation**		
	2013-14	**2014-15**	**2015-16**
Mean yield (Kg/ha)	727	2280	2530
Price (Rs./Kg)	16.7	22.3	17.3
Gross Income (Rs./ha)	12140	50844	43769

Growth and yield performance of cocoa

Cocoa: Cocoa seedlings were planted in alternate rows to give a spacing 2.7 m x 5.4 m. Cocoa plants were pruned in August- September and shaped to get a canopy at a height of 1.5 to 2.0 m. Cocoa plants started yielding in demonstration plots from 2014-15 onwards. Yield stabilization will take another four years and will sustain for another

thirty years so that farmers can reap maximum profits from cocoa. One tree will yield about 3 to 3.5 kg wet beans per year. Growth performance, yield and income details are given in Table 5.

Table 5. Yield performance of cocoa

Particulars	**Year of observation**	
	2014-15	**2015-16**
Mean yield – Wet beans (Kg/ha)	25.7	180
Price (Rs./Kg)	58.0	56
Gross Income (Rs./ha)	1490	10080

Growth performance of black pepper

Black pepper is an excellent crop for mixed cropping. Arecanut stems were used as live standards for training black pepper, two rooted pepper cuttings were planted on the northern side of the palm dug at a distance of 75 cm from the base. Pepper vines planted were well established and started giving yield from 2015 onwards (Table 6). Yield stabilization will take another four - five years and will sustain for another twenty years so that farmers can reap maximum profits. One vine will yield about 0.5 to 1 kg dry black pepper per year.

Table 6. Yield and returns from black pepper

Particulars	**Year of observation**
	2015-16
Mean yield (Kg/ha) – Dry berries	4.8
Price (Rs./Kg)	540
Gross Income (Rs./ha)	2592

Knowledge of the beneficiaries

Knowledge test was administered to the beneficiaries during pre demonstration, mid term and post demonstration using pretested interview schedule consisting of 15 knowledge items covering crop improvement, crop production, crop protection, post harvest processing aspects. Maximum score obtainable was fifteen and minimum was zero. There was significant improvement in the knowledge of the

beneficiaries over the years as given in the Table 7. Knowledge will play a definite role in adoption of improved technologies and also helps other farmers by way of dissemination.

Table 7. Knowledge of the beneficiaries on arecanut based cropping system

Pre (2012-13)	Mid (2014-15)	Post (2015-16)	Difference
6.4	11.7	13.2	6.8

Economic impact of arecanut based cropping system

The cropping system consisting of arecanut, banana, cocoa, black pepper enhanced the profitability from unit area over the years as given in Table 8. Significant improvement was observed between the pre demonstration (2011-12) and post demonstration (2015-16) due to adoption of cropping system approach.

Table 8. Economic impact of cropping system

Crop	Income (Rs.)				
	2011-12	2012-13	2013-14	2014-15	2015-16
Arecanut	339465	410375	347100	575608	652800
Banana	-	-	12140	50844	43769
Cocoa	-	-	-	1490	10080
Black pepper	-	-	-	-	2592
Total	339465	410375	359240	627942	709241
% increase	-	20.89	5.83	84.98	108.93

Incidence of pests and diseases

Pests and diseases were observed in the demonstration plots and suitable recommendations were provided to the beneficiaries. Scale insects, pentatomid bug, fruit rot and die back in arecanut, leaf eating caterpillar and beetles in cocoa, leaf roller, bunchy top and sigatoka leaf spot in banana and quick wilt in black pepper were managed with integrated pest and disease management practices.

Transfer of technology programmes: The major objective of participatory technology transfer is to disseminate the technology to

larger farming community by showing the feasibility of technology in their local conditions. Four training programmes, one seminar and field day were organized with the active participation of arecanut growers, CPCRI, Directorate of Arecanut and Spices Development, Kozhikode, Department of Horticulture, Belthangady, Puttur & Kasaragod, Krishi Vigyan Kendra, Mangalore & Kasaragod and Media.

Marketing and Processing

Marketing and processing of arecanut and cocoa has been a major concern for the growers as most of the produce sold through unorganized sector which led to price volatility making the farming not remunerative. However, agencies like CAMPCO and Cadbury India Ltd. have been helping the arecanut and cocoa growers for enhancing the profitability of farmers as given below.

Central Arecanut & Cocoa Marketing & Processing Co-operative Limited (CAMPCO)

'CAMPCO' was started on 11th July 1973 as a multi state co-operative - a joint venture of the states of Karnataka and Kerala under sec.7 of the Karnataka Co-operative Societies Act read with sec. 4(2) of the Multi State Co-operative Societies Act 1984. Starting with its Head office at Mangalore in coastal Karnataka, the CAMPCO began with a handful of procurement centers in Karnataka and Kerala. CAMPCO adopted a safe policy for purchasing and marketing the commodity and maintaining standards in quality with the dedicated cooperation of a network of diligent officers and workers.

The co-operative encouraged growers to take-up cocoa cultivation as an inter crop in the latter half of the 70's as a supplemental crop. This grew up to become a large scale operation with good results. A sudden withdrawal by the buyers of cocoa from the procurement operations due to crash in the international market came as a shock to cultivators. Karnataka and Kerala governments enthused at this stage the CAMPCO to enter on the scene to rescue the farmers from distress. CAMPCO willingly took up the responsibility to enter the cocoa market and performed a savior's role. It procured cocoa pods from growers and adopting scientific processing methods to market standards, released

dry cocoa beans matching in quality in the world market to that of Ghana, Brazil and other leading Cocoa cultivating nations. With a view to creating a permanent demand and a steady market for the beans, CAMPCO established a Chocolate Manufacturing factory at Kemminje village in Puttur Taluk of Dakshina Kannada adopting foreign technical collaboration in chocolate making. The factory was set up in 1986 at an initial investment of RS.116.7 million and a licensing capacity to produce 8800 metric tonnes. It has been producing a variety of products - semi finished items like cocoa mass, cocoa butter and cocoa powder and finished products in moulded line, count line, chocolate drink etc. CAMPCO chocolate has gained extensive market popularity in India. The main activities of CAMPCO for cocoa promotion are given below.

- Procuring arecanut and cocoa grown by member cultivators and if necessary, from other growers on an agency basis or on outright purchase basis.
- Sale of srecanut and cocoa and their products to the best advantage of members and also to advance loans to members on the pledge of goods
- To promote and develop areca and cocoa cultivation, marketing and processing.

Cadbury India Ltd. (Mondelez India Foods Private Ltd.)

Cadbury India Ltd was incorporated in the year 1948 as a private limited company with the name Cadbury Fry (India) Pvt. Ltd. The company began their operations in India by importing chocolates. In the year 1950s, the company started the manufacture of chocolate and Bournvita. In the year 1960s, the company set up a Cocoa Research Centre in Kerala. In May 2008, the company joined hands with Tamil Nadu Agricultural University to promote cocoa cultivation in Tamil Nadu. Cadbury India Ltd. (Mondelez India Foods Ltd from April, 2014) also plays an important role in area expansion programme of cocoa through various schemes. The company has its field offices/ branches in four southern states viz., Kerala, Karnataka, Tamil Nadu and Andhra Pradesh where cocoa is grown. Major activities of Cadbury for cocoa development are given below.

- Supply of cocoa seedlings
- Supply of critical inputs
- Arranging interaction between scientists and farmers
- Technical guidance on crop production, protection and processing
- Buy back arrangements
- Procuring cocoa beans from growers (wet/ dry beans)

Conclusion

Arecanut based multispecies cropping system provides additional income and also act as an income security against instability in price of main crop. It has potential to generate employment opportunities for improving the quality of rural life. Proper choice of crops and their quality planting materials is a prerequisite for a successful cropping system. The scientific rationale behind multiple cropping needs to be understood by the areca growers before adopting it. It is strongly believed that participatory technology transfer is the need of the hour to make the farming profitable and sustainable. But at the same time, PTT is not a substitute for conventional TOT model. It is a complementary process which does linking the power and capacities of researchers, extension workers and development departments to the priorities and capacities of farming communities, in order to develop productive and sustainable farming systems.

References

Bavappa, K. V. A., Abdul Khader, K. B., Biddappa, C. C., Khan, H. H., Kasturi Bai, K. V., Ramadasan, A., Sundararaju, P., Bopaiah, B. M., Thomas, G. V., Misra, L. P., Balasimha, D., Bhat, N. T. and Shama Bhat, K. 1986. Coconut and arecanut based high density multi-species cropping systems. Journal of Plantation Crops 14(2):74-87.

Hagmann, J., Chuma. E., Conolly, M. and Murwira, K. 1998. Client-driven change and institutional reform in agricultural extension: an action learning experience from Zimbabwe. AgREN Network Paper No. 78. ODI, London. (Downloadable from the ODI website: www.odi.org.uk/agren

Havercort, B. Hiemstra, W., Reijntjes,C and Essers, S. 1991. Strengthening farmers' capacity for technology development, ILIEA 4(3): 10-18.

Jaganathan, D. and Nagaraja, N. R. 2015. Perception of farmers about arecanut based multispecies cropping system. Indian Research Journal of Extension Education.15(2): 49-54.

Jaganathan, D., Elain Apshara, S. and Jose, C. T. 2013. Arecanut based multispecies cropping system – A success story. Indian Journal of Arecanut, Spices and Medicinal Plants.15 (1): 40-44

Jayasekhar, S., Jose, C. T., Thamban, C. and Muralidharan, K. 2012. Economic impact of arecanut based cropping systems: A study of Dakshina Kannada district, Karnataka. Journal of Plantation Crops 40(1): 50-55.

NHB. 2015. National Horticulture Board website. nhb.gov.in.

Scoones, I. and Thompson. J. 1994. Beyond farmer first. Rural people's knowledge, agricultural research and extension practice. London: Intermediate Technology Publications (IIED).

Innovative extension approaches for plantation crops (2016) : 223-233
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Participatory technology transfer programmes in oil palm

Prasad, M.V. and Mary Rani, K. L.

Introduction

Sustainability in agriculture depends upon encouragement as well as motivation of farming community and their involvement in developing micro situation specific technologies. There is increasing realization that generation and transfer of technology should be tuned to fit into the local conditions, crop or situation specific and knowledge available. Participatory process for technology generation and transfer need to be designed appropriately for the benefit of stakeholders.

Participatory approaches are bottom up, people centred and demand driven with top down, government centred and supply driven development of the past. Analyzing location specific problems through participatory rural appraisal techniques and working out appropriate remedies by harmonizing available indigenous knowledge with technically developed innovations under diverse micro situations are major considerations of the current research and development programmes in agriculture.

Participatory approach is an important initiative to decentralize decision making process and promote oneness among the farming communities. These paradigms of development are required for sustainable improvement of socio economic conditions of resource poor stakeholders. In this process, the real issues are analysed by sharing experiences and knowledge of local communities and external service providers. Available new technologies are required to be assessed,

appropriately refined in their specific micro environment. These technologies need to be merged with traditional knowledge if available for acceptance and transferred for adoption among farmers.

Oil Palm plays a significant role to meet the vegetable oil requirements in India, because of its highest productivity (4-6 tons of oil per hectare) with more returns to the farmers than any other edible oil yielding crop. In India the net area under oil palm cultivation is 2.68 lakh ha and there is a great scope to increase the area yet further. The average yield in India is 3.5 t/ha against the average potential yield of 20 t/ha under well managed conditions by the farmers.

In India, a well developed network of oil palm research system is available at present and the system is bringing out high return technologies that are applicable to different situations. However, our farmers are not able to exploit the production potential from these technologies to the extent desirable. Extent of adoption of the recommended practices plays a crucial role in improving the productivity in agriculture.

Study conducted on Institution Village Linkage Programme for technology assessment and refinement in coastal Agro-Ecosystem in West Godavari district of Andhra Pradesh by Prasad *et al.*, 2005, revealed that adoption of recommended dose of fertilizers in oil palm increased the Fresh Fruit Bunch (FFB) yields by 17-24 per cent and reduced the nutrient deficiencies. Application of Phorate granules @ 20 g/palm in the spindles along with castor cake baiting and treating the breeding sites with green muscardine fungus reduced the incidence of Rhinoceros beetle in Oil Palm. Application of 0.2 % Carbendazim in the crown region effectively controlled the bud rot in oil palm.

Study conducted on performance of oil palm production technologies in Andhra Pradesh, Karnataka and Goa by Prasad *et al.*, 2010 revealed that majority of the oil palm growers were marginal (31.59%) and small farmers (27.91). Most of the respondents (74.61%) were following basin method of irrigation with four to seven days interval (29.84%) to irrigate the palms. More than eighty per cent of the farmers were applying farmyard manure. Most of the respondents were applying lower doses of Nitrogen (54.07%), Phosphorus (42.64%) and

Potassium (34.69%) and majority of the farmers were not applying micronutrient fertilizers. Majority of the farmers (34.69 %) were applying fertilizers in 2 split doses.

Study conducted on farmers' adoption pattern in high yielding oil palm plantations (≥ 20 tonnes of fresh fruit bunches/ha) by Prasad *et al.*, 2013 revealed that oil palm package of practices/technologies are being adopted in various degrees and pattern. Majority of the high yielding plantation farmers obtained high yields from their 11-16 years age oil palm plantations. They were applying Farm Yard Manure and different dose of fertilizers in their oil palm plantations. Majority of them were applying fertilizers in 3-4 splits. Study indicated a significant correlation between yield and fertilizer applied in number of splits and application of magnesium.

There have been some recent innovations in introducing farmer participation and group approaches into extension. The extension personnel may have to follow an appropriate strategy to suit to the local conditions which would simultaneously ensure higher levels of farmer participation.

Technology transfer strategies

Introduction of oil palm in India, as new oilseed crop under irrigated conditions necessitated for an effective technology transfer. This would be possible, if the officials involved in oil palm development and farmers are equipped with knowledge and skills in oil palm production. These farmers and officials would use their human resources to motivate other farmers to grow oil palm, area expansion and increase oil palm production, provided demand driven or location specific problems are solved. Few such initiatives / strategies adopted in technology dissemination programmes of IIOPR, to attain high productivity by the oil palm growers are discussed below.

Oil Palm productivity improvement through Farmer Field School approach

Farmers Field School approach is based on the concepts and principles of people centred learning and was developed as an alternative to the

conventional top-down training and visit extension approach. It uses innovative and participatory methods to create a learning environment, including learning networks, in which the farmer have the opportunity to learn for themselves about particular crop production problems, and ways to address them, through their own observation, discussion and participation in practical learning by doing field exercises. This approach is now being used to enable farmers to investigate and overcome, a wider range of problems, including soil productivity improvement, conservation agriculture, control of pest & disease, surface runoff, water harvesting, management of irrigation and fertilizer etc.

Telikicherla village in West Godavari District was selected to implement Farmers Field School. Participants were selected among oil palm growers, who had shown interest and formed members in a cluster. Twenty five voluntarily willing oil palm growers were selected. After selecting participants, bench mark survey was conducted in the village to know the cropping systems, inputs, constraints and options available to solve the problems through farmers' field school.

In the first meeting, members were appraised about the objective of the field school, their involvement to achieve the objective etc. Oil Palm farmers were asked to list out the constraints encountered in achieving high yields in oil palm. Matrix ranking was prepared by the oil palm growers through group dynamics exercise. Thus perceived constraints in oil palm cultivation were listed and prioritised by the farmers. Based on their ranking, field schools were conducted on viz., irrigation requirement, identification of moisture stress symptoms and management; nutrient requirement, identification of deficiency symptoms and management; identification of pest infestation and control measures; identification symptoms of disease infection and control measures; mechanisation in oil palm.

Date and venue of the field school was informed to the farmers through SMS, few days prior to the field school conducted. In each field school, activity / programme and relevant literature was provided to the participants. Pre and post evaluation was conducted through a group activity by identifying correct answer and keeping the relevant choice slip in pouch kept at each palm trunk. Each participant is

provided with choice slips and asked to choose the correct answer and keep appropriate slip to each question placed in the pouch kept on the oil palm trunk. Thus group learning activity was evaluated and studied. Discussions were held immediately after the session. Farmers were involved in identification of symptoms of moisture stress, pest/ disease infestation, nutrient deficiency etc. Farmers were involved in identification, collection of leaf and soil for analysis; handling of tools and machinery for ablation of inflorescence, harvesting of bunches etc. Each field school was conducted separately in different farmer field, thus covered majority of oil palm plantations.

It was observed that considerable interest has been created among farmers to adopt the practices to get high productivity. Majority of the oil palm plantations were free from moisture stress and nutrient deficiency symptoms. Farmers themselves organised soil and leaf collection camps during summer and collected 64 samples. IIOPR analysed soil and leaf samples and recommendations provided. Average productivity increased by 25 per cent.

On farm farmers training programmes

On farm training programmes were organized based on need and request from the farmers through department of agriculture/ horticulture and entrepreneurs. The programmes were of one or two days duration. Problems were identified by the group of oil palm farmers of village. They approached organisations viz., Department of agriculture / horticulture / oil palm processing unit of their zone for remedy. Respective organisations approached IIOPR for organising on farm training cum demonstration programmes. Thus IIOPR organised programmes on the topics viz., recommended practices for oil palm cultivation, irrigation and nutrient management in oil palm, plant protection in oil palm, harvesting of fresh fruit bunches from tall palms and intercropping in oil palm.

These programmes were organised at regular intervals every year on farm depending on need and availability of physical facilities. A total of 21,769 farmers belonging to Andhra Pradesh (13,817), Karnataka (3375), Tamil Nadu (3417), Kerala (25), Goa (426), Gujarat (552),

Orissa (102) and Mizoram (55) were trained. Trained farmers felt the training was beneficial and they are in high knowledge and medium adoption category (Prasad and Raju 2004).

Diagnostic field visits

Oil palm growers are approaching department of agriculture / horticulture / oil palm processing unit of their zone to overcome unknown problem in their oil palm plantation. The problems which were not solved by above agencies are referred to IIOPR for remedy. Multidisciplinary scientist teams were deputed to diagnose the field problems and suggest corrective measures. Diagnostic field visits were conducted in Andhra Pradesh, Goa, Maharashtra, Gujarat, Mizoram, Odisha, Kerala, Tamil Nadu and Karnataka.

Skill development programmes

Farmers and grass root level field functionaries were given skill development training programmes on oil palm technologies. Farmers in Mizoram identified bunch failure in their oil palm plantations. A thorough investigation has been done by multidisciplinary scientists team and identified the cause is due to lack of pollen in oil palm plantations. Suggested inundated release of pollinating weevil. Farmers and field staff of respective processing units were trained on skill to identify correct stage of receptivity of female inflorescence and stage at which pollen from male inflorescence need to be dusted. Assisted pollination kits were also distributed to facilitate assisted pollination based on requirement.

Technical staff and other personnel involved in oil palm hybrid seed production were provided skill development programmes to get quality oil palm hybrid seeds. They were given hands on experience to identify male and female parents and processing of hybridised bunch, processing the seed for germination to packing etc.

Kisan Mobile Message Services

Oil Palm growers are frequently approaching IIOPR to know technical information about oil palm cultivation. Observing the advantages of mobile applications, Indian Institute of Oil Palm Research started Oil

Palm Kisan Mobile Message Services (OPKiMMS) during February 2012 to disseminate oil palm technology in a timely manner to all the oil palm stakeholders (Mary Rani *et al.*, 2011) consisting of oil palm growers, field extension staff of state Department of Agriculture/ Horticulture and extension staff of oil palm processors to take quick and apt decisions in oil palm cultivation.

Contents for these messages were prepared based on the queries raised by the farmers / other oil palm stakeholders in the form of emails, telephone calls, letters, queries raised during seminars, interaction/ interface meetings etc. Message contents covered different aspects of oil palm cultivation at various growth stages. Considering the farmers preference for local language, the customized content was prepared and published in four vernacular languages to oil palm growers of different states at regular interval. Need based customized contents were also prepared and published based on farmers' calls. Situations like pest / disease attack in specified location, cyclone affected areas were given special attention and messages were published.

The SMS published contained the contact details of IIOPR for further queries and clarifications. This helped the farmers to contact the Institute for clarifying their doubts and to acquire further information. It also helped in collecting the feedback from the farmers on the service provided. Feedback received from growers on various aspects of oil palm cultivation through phone in survey. Farmers approached IIOPR for fertilizer management (34.21 %) followed by crop protection aspects (28.29 %) and general information (24.01 %) pertaining to oil palm cultivation viz., feasibility of the crop, soil pH, EC and irrigation requirements for juvenile and adult plantations, subsidies, seed availability etc.

The usefulness of subjects as perceived by the farmers were as follows viz., irrigation (15%), fertilizer application (14%), disease management (8%) and weed control (4%). However, 59 % of the farmers expressed that all the messages that are being sent are useful. Farmers (68%) have indicated that the messages are relevant to their crop growth/stage and 33% of the farmers responded that they are adopting the practices disseminated through SMS. (Prasad *et al.*, 2015)

Video conferencing for rapid dissemination of information

The video conference system established during 2014-15 in the institute was used to reach the stakeholders. The video conferencing approach was used in scheduling and implementing interface programmes at regular intervals involving various stakeholders including researchers, extension personnel, farmers and oil palm entrepreneurs for oil palm development. Feedback obtained in pre meeting video conference sessions from various stakeholders for conducting video conference sessions on specified subject. It enabled interaction of oil palm growers, field staff at remote places with subject matter specialists of the institute and other centres thereby reducing time, effort and cost in transfer of oil palm technology. Availability of such facility to disseminate oil palm information at single source will facilitate the oil palm grower to take instant decision and act accordingly. This facilitated participatory approach to address location specific problems and interpersonal interaction to provide guidance to field problems.

Interface meets

In order to discuss policy issues, implementation of oil palm development programme, views, experiences, constraints in oil palm cultivation and suggestions to overcome the constraints in oil palm cultivation, interface meets were organised from time to time decided by the forum. Interface forum consists of policy makers, administrators, scientists, developmental officials, entrepreneurs and farmers. The interface meets organised on various topics viz., How to make oil palm more remunerative, Oil Palm Research and Development, Market intervention Scheme, Recent developments in Oil Palm Production and Processing Technologies, How to make Oil Palm More Sustainable, Problems and Future Strategies for Sustainable Production in Oil Palm and Priorities for Oil Palm Research and Development and a total 1406 personnel participated in 20 interface meets.

Farmers study tours

Interested farmers from new areas (to cultivate oil palm) or oil palm growers from different states, where adult oil palm plantations are not available were brought to IIOPR on study tours to expose them

to fields of successful oil palm growers, processing units in Andhra Pradesh and technologies available with IIOPR. They were explained about technologies available to grow oil palm and visits were arranged to farmers fields and processing unit. Farmers from Andhra Pradesh, Karnataka, Tamil Nadu, Goa, Gujarat, Orissa and Mizoram came on study tour and underwent one day field exposure and hands on experience to use tools and machinery to harvest oil palm bunches.

Participatory technology assessment and transfer

A project on Technology Assessment and Refinement through Institute Village Linkage Programme was implemented at Pedakadimi village, West Godavari district by IIOPR to identify and prioritize the farmers' problems in oil palm cultivation. Under upland production system oil palm is predominant crop. Oil Palm is a newly introduced crop and appropriate package of practices have been evolved for the crop. However due to lack of awareness, many farmers are not adopting recommended practices. Fertilizer application is the key input in oil palm production, which is often neglected by the farmers as a result they are realizing low yields. To attain sustainable high yields in oil palm cultivation, intervention on "Integrated nutrient management through application of fertilizers and micro-nutrients in oil palm" was implemented in Pedakadimi. Recommended technology is application of NPK @ 1200g: 600g: 1200g, 500g of Mg So4 and 100g of boron/ palm/year, if the age of the palm is more than 6 years and yield is 15 tonnes or more per hectare, the fertilizer dose need to be increased by 20%. Thus fertilizer dose would be 1440g N: 720g P: 1440g K. Recommended fertilizers were applied in 3 splits. While implementing the intervention, farmers were given two days training on '' Oil Palm cultivation" at IIOPR.

Sri D. Basavaiah (64 Years) with 1.2 ha of oil palm plantation was selected for implementation of this intervention. Due to partial adoption of recommended practices he was getting 13 to 15 tones of fresh fruit bunches/ ha/year. Under the intervention, fertilizers were applied @ 1440g N: 720g P: 1440g K, 500g of Mg So4 and 100g of boron in three splits / year. Yield data was collected two years after application of increased doses of fertilizers. Data revealed that yield

was increased by 22% and 15% over the farmer's practice in 2002-03, 2003-04 respectively. He felt that though the monsoon failed he could get increased results due to application of recommended fertilizers in three splits. By the continuous use of recommended dose of fertilizer application there has been a 17% increase in the FFB yield over the farmers practice in 2004-05 and the net returns were increased from Rs.1,06,149/ha to Rs. 1,24,227/ha. He is getting bunches throughout the year and harvesting at regular intervals and earns twice or thrice a month. He got convinced about the practice and he is disseminating the same to other oil palm growers of neighboring villages.

Conclusion

For successful and sustainable agricultural development, farmers' participation in transfer of agricultural technology is regarded as important criteria. Adoption of recommended practices is crucial to improve productivity of the crop. This requires effective technology transfer to equip oil palm stakeholders with knowledge and skills in oil palm production. Appropriate participatory technology transfer approaches for different stakeholders, based on their requirement may be devised for effective dissemination of agriculture technology to meet the stakeholders' needs in achieving high productivity.

References

Arulraj, S. 2002. Emerging public-private sector and user partnership in technology utilization process. Asia Regional Conference on "Public-private sector partnership for promoting rural development" organised by Bangladesh Agricultural Economists Association and International Association of Agricultural Economists at Dhaka, Bangladesh during October, 2-4, 2002.

Arulraj, S. and Prasad, M. V. 2014. Participatory technology transfer programmes for enhancing oil palm production. In Participatory technology transfer approaches for plantation crops (Ed: Thamban *et al*). Central Plantation Crops Research Institute, Kasaragod, Kerala. 87-96.

Mary Rani, K. L., Prasad, M. V., Krishna Hemanth, G., Srinu, G., Bharathi Arora and Arulraj, S. 2011. Dissemination of oil palm

technology through information and communication technology. International Journal of Oil Palm Research. 8(1&2) : 31-33.

Prasad, M.V., Mary Rani, K. L., Suresh, K., Reddy, V, M. and Kalidas, P. 2005. Technology Assessment and Refinement through Institution Village Linkage Programme (Genesis, Assessment, Refinement and Success). National Research Centre for Oil Palm, Pedavegi, Andhra Pradesh, Pp. 65.

Prasad, M.V., Sarkar, A. and Jameema, J. 2010. Performance of oil palm production technologies. Indian Research Journal of Extension Education 10(3): 10-15.

Prasad, M. V., Ananta Sarkar, Mary Rani, K. L. and Jameema, J. 2013. Adoption pattern of high yielding oil palm plantation farmers - A survey. Journal of plantation crops, Kasargod, Kerala. Journal of Plantation Crops, 2013, 41(1): 105-108.

Prasad, M. V., Mary Rani, K. L., Arulraj, S. and Krishna Hemanth, G. 2015. Oil Palm Kisan Mobile Message Services - A New Paradigm in Technology Dissemination. Indian Research Journal of Extension Education, 2015, 15(2): 100-104.

Innovative extension approaches for plantation crops (2016) : 234-242
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Extension approaches for spices development-Institutions and programmes

Rajeev, P. and Lijo Thomas

Introduction

India produces a wide range of spices. At present, production is around 3.2 million tonnes of different spices valued at approximately 4 billion US $, and holds a prominent position in world spice production. Because of the varying climates - from tropical to sub-tropical to temperate-almost all spices grow splendidly in India. In reality almost all the states and union territories of India grow one or the other spices. Under the act of Parliament, a total of 52 spices are brought under the purview of commercially cultivated spices. However, total of 109 spices are notified in the ISO list.

India is the largest producer, exporter as well as consumer of spices. Indian Institute of Spices Research, a premier research institute under ICAR deals with seven tropical spices. These are Black pepper, Small cardamom, Ginger, Turmeric, Nutmeg, Cinnamon, Clove, Vanilla and Garcinia. Black pepper and cardamom are mainly cultivated as cash crops in Western Ghat belt and being raised on a plantation scale, these crops support a sizeable proportion of farming community and agriculture labour. These crops essentially form a part of Coffee and Tea plantations in South India region. Investment in the farming sector is greatly influenced by high price volatility of most of the spices. The price instability could be attributed to the changes in global supply during the post liberalization period, with many new entrants in the production and trade scenario like Vietnam and Thailand in case of black pepper and Guatemala in case of cardamom and other factors like fluctuations in production.

Extension Approaches

The technology adoption behavior of farmers growing spices, the diffusion of scientific technologies among the farming community and the extension services in vogue can be defined in three perspectives. 'Commodity Extension services' 'Demand driven' and 'Market led'. (T Birner *et al.*, 2006; Birner and Anderson 2007; Davis 2008; Hall *et al.*, 2000; Kokate *et al.*, 2009; Sulaiman and Hall 2008; Swanson 2009.) To understand the strategies and approaches adopted for formulating extension programmes by the various players, one has to consider the features of the spices crop sector per se. Spices are high value crop consumed in low volumes. Many tropical spices are perennial crops eg: Black pepper is perennial climbing vine and small cardamom is a perennial shrub. Many of these crops are cultivated both at subsistence scale as well as commercial scale. Black pepper and small cardamom are frequent mix crops in commercial coffee and tea gardens. Also with increased adoption of scientific technologies a clear transition from subsistence to commercial scale is evident. Another important aspect is the trade significance of these crops because of their share in the export market. Because of the growth of the sector is viewed in an historical and economic context of establishment, the extension approaches are often termed as "Commodity Extension Services". As they are traded commodities across world markets, price mechanisms and structure are highly influenced by both domestic and international markets. The supply of many spices comes from only a few countries. The close link of these crops to the market influences the decisions of the farmers on management as well as investments. In this context the extension services envisaged are termed as "market lead". In other words extension programmes must improve linkages of production systems with marketing, agro-processing and other value added activities of these crops (Kumar *et al.*, 2012). Because of the commodity nature and market links of the crops, the farmers engaged in cultivation represent 'interest groups" from an organizational context. Most of these crops are not only labour intensive, but also require skilled labour which are difficult to be replaced by Machinery. Due to the significance of labour market and representation of farmers' interest groups, the extension approaches are termed as "Demand Driven".

Extension programmes and Institutions

Indian Institute of Spices Research under ICAR implements front line extension services through planned projects. Two major National Level Agencies (NLA) offering development services to spice growing farmers are Spices Board under the Ministry of Commerce of Government of India and Directorate of Arecanut and Spices Development under the Ministry of Agriculture and Cooperation, GOI. The national Extension system for spices is depicted in Fig. 1. The state Department of Agriculture is another player in providing extension services. As per provisions in the state plan as well as Central aided project funds the department offers field extension services in spices for the farmers. Some programmes are also implemented through Panchayat Raj Institutions (PRI). The state Agricultural Universities through their extension projects offers educational, information and communication services to farmers. Various institution engaged in providing extension support in spices is given in Fig. 1.

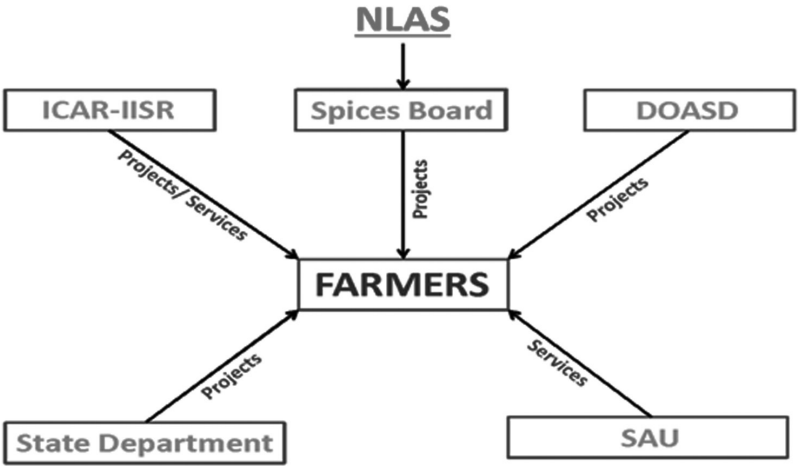


Fig. 1. Extension agencies for spices

ICAR-IISR - Projects and strategies

Under innovation technology demonstration component of NATP, the ICAR established Agriculture-Technology Information Centre (ATIC) in State Agricultural Universities to work as single window support system linking the various units of research institution with intermediary

users and farmers in decision making and problem solving exercise through availability of technology inputs, products, information and advisory services under one roof. This centre started functioning in IISR in the year 2000. Krishi Vigyan Kendra (Farm Science Centre) is an innovative institution of ICAR established at district level in 1974. KVKs play a vital role in conducting on farm testing to identify location specific agricultural technologies and demonstrating the production potential of crops at farmers' fields through frontline demonstrations. They also conduct need based training programmes for the benefit of farmers and farm women, rural youths and extension personnel to update their knowledge and skills and to orient them in the frontier areas of technology development. KVKs are creating awareness about improved agricultural technologies through large number of extension programmes. Critical and quality inputs like seeds, planting materials, organic products, biofertilizers are produced by the KVKs and made available to the farmers. Agricultural Knowledge and Resource Centres are set up at KVK to support the initiatives of public, private and voluntary sectors at district level.

Spices Board: Projects and Strategy

1. Export Oriented Production Programmes

The Spices Board is implementing the XII plan programmes for development of cardamom (small & large) and post-harvest improvement of other spices under the head Export Oriented Production. Export Oriented Production is broadly divided into

- Production improvement programmes meant for small & large cardamom
- Post-Harvest improvement as a part of quality improvement of spices for export
- Extension support for both the above programmes.

These programmes mainly cover two crops, small cardamom and large cardamom. The strategy is to popularize and facilitate adoption of improved technologies like quality planting material, Good Agricultural Practices (GAP) kits, and mechanization on both on farm

and for post harvest operations and irrigation and land development. All the programmes are subsidy linked.

The Board is also implementing Post harvest improvement programmes for other spices for popularizing available technologies like Seed spice thresher, Pepper thresher, Bamboo mats, Turmeric polisher, IPM kits for Chilli, polythene/silpauline sheets for drying, Mint distillation unit, Pepper/clove ladders for harvesting, Spice cleaners/graders, Tamarind/nutmeg dehuller, nutmeg driers. Packing and storage unit for garlic, Herbal spice extractors & Dehydration units, Dry/fresh ginger peeling & storage unit ,Seed spice cleaning & storage unit and spice washing equipment.

2. Programmes for Export Development and Promotion

Infrastructure Development Scheme (IDS) is a high end scheme which has three components.

- Adoption of advanced technologies in spice processing
- Technology and process upgradation
- Setting-up/up-gradation of in-house quality control laboratory
- Quality certification such as ISO 22000, SQF 2000, GMP traceability, FDA registration
- Validation of check samples and training of laboratory personnel.

For high end spice processing, technology/process up gradation and setting up of in house quality control lab, grants are given by the board based on clear guidelines and norms for purchase and establishment of machinery/ equipments.

Directorate of Arecanut and Spices Development - Projects and Strategies

The Directorate of Arecanut and Spices Development, Calicut, a subordinate office under the Ministry of Agriculture, has the national mandate for the development of arecanut, spices other than cardamoms and aromatic plants. The Directorate implements Central Sector /Centrally Sponsored Schemes for development of these crops at National level. Since the launch of National Horticulture Mission (NHM) programmes in the country from 2005-06, the Directorate was entrusted with the responsibility of coordinating and monitoring

the mission programmes assigned to various State Governments on the mandate crops. In addition, the Directorate directly implements certain programmes such as production of nucleus planting materials of high yielding varieties, technology transfer through frontline demonstration plots, National Seminar/Workshops, Farmers Training etc.

The programmes are implemented in association with State Agricultural Universities (SAUs), Indian Council of Agricultural Research (ICAR) Institutes and reputed NGOs across the country.

State government - Projects and Strategies

The Sugandhi Pepper Rehabilitation Programme and Pepper Development Programme for North Kerala are state sponsored projects. The projects are operating on a 'Consortium' mode involving, SAU, IISR and State Department. These comprises of programmes for establishment of decentralized nurseries, assistance for planting of new standards, establishment of demonstration plots and revitalization of Pepper Farmers groups. Major functional components are

- Expert team members for the diagnostic field visits
- Collection and transportation of soil samples for analysis
- Conducting participatory rural approaches and workshops
- Compilation of the soil analysis results and preparation and distribution of pepper health cards
- Importing training to farmers at various levels
- Conducting FLD's and feedback.

Case study on participatory approaches

Participatory Plant Breeding (PPB) involves scientists, farmers, and others, such as consumers, extensionists, vendors, industry, and rural cooperatives in plant breeding research. It is termed 'participatory' because users can have a research role in all major stages of the breeding and selection process. Such 'users' become co-researchers as they can: help set overall goals, determine specific breeding priorities, make crosses, screen germplasm entries in the pre-adaptive phases of research, take charge of adaptive testing and lead the subsequent seed multiplication and diffusion process (Sperling and Ashby,1999). In

perennial crops like tree spices the role of participatory breeding for crop improvement and development of varieties because of one reason; the long gestation period of the crop. Efforts of one single institution or individual for that sake may not produce deliverable out comes. The required time, efforts and investments are more and hence a multi stake holder initiative is important. Based on the incentives that govern how farmers and scientists will share the responsibility, the work and the benefits of a joint plant breeding effort, there are two approaches of PPB. one when farmers join in breeding experiments which have been initiated by formal breeding programs which we term 'Formal led PPB' and another when scientists seek to support farmers own systems of breeding, varietal selection and seed maintenance called as farmer led participatory plant breeding

Kerala sree- Nutmeg Variety: Kerala sree is the first and only variety released by the ICAR at National level in tree crops. It is a high yielding high quality nutmeg variety for which credentials are shared by ICA Indian Institute of Spices Research, Kozhikode and a farmer named Mathew Sebastian in Malppuram district. This can be typically illustrated as farmer lead PPB with following distinctive features with respect to roles and responsibilities of stake holders, benefit sharing and spread and diffusion of such efforts. Researchers or other professionals in farmer-led programs facilitated a process in which farmers establish breeding objectives. Farmers bear took up the responsibility for and, often, the costs of conducting experiments, selecting materials for seed multiplication, and dissemination of these. Researchers took a support role in this process. The main breeding objective was to provide varieties or populations which suit the specific local environment and local preferences and any broader applicability

Conclusion

The strategies adopted for the extension programmes in spices sector are defined form three perspectives;"Commodity oriented", "Market lead" and "Demand driven". Many progarmmes aim at improving and fostering linkages of production systems with marketing, agro-processing and other value added activities of these crops. The national extensions system for these crops is pluralistic involving National Level

Agencies (NLAs) as well as state and local institutions. The ICAR led system focuses on front line extension services, while the commodity board focuses on export oriented production and export promotion. The Directorate under the Central Ministry of Agriculture adopts programmes for integrated development of the sector and national level coordination of extension efforts. The state adopts need based location specific schemes involving Panchayati Raj Institutions also.

References

Birner, R., K.Davis, J.Pender, E. Nkonya, P.Anandayasekeram, J.Ekboir, A.Mbabu, D.Spielman, D.Horna, S.Benin, M.Cohn. 2006. From "best practice" to "best fit": A framework for analyzing pluralistic agricultural advisory services worldwide. DSGD Discussion Paper 37. Washington, D.C.: International Food Policy Research Institute.

Birner, R., and J. R. Anderson. 2007. How to make agricultural extension demand-driven? The case of India's agricultural policy. IFPRI Discussion Paper 00729. Washington, D.C.: International Food Policy Research Institute.

Davis, K. 2008. Extension in sub-Saharan Africa: Overview and assessment of past and current models, and future prospects. Journal of International Agricultural and Extension Education 15(3): 15–28.

Hall, A., 2000. Coping with new policy agendas for agricultural research: The role of institutional innovations. ICAR Policy Brief 13. New Delhi: Indian Council of Agricultural Research.

Kokate, K. D. 2009. Farmers-led extension: Experiences and road ahead. Indian Research Journal of Extension Education 9(2):18–21.

Kumar, R, Singh B. P. and Kaswan S. 2012. Production Driven To Market Driven Extension Approach, Indian Research Journal of Extension Education, Special Issue (Volume II)

L. Sperling, J.A. Ashby, M.E. Smith, E. Weltzien & S. McGuire. A framework for analyzing participatory plant breeding approaches and results. 2001. Euphytica 122: 439–450, 2001. Kluwer

Academic Publishers.

Sulaiman, R., and A. Hall. 2008. Beyond technology dissemination: Can Indian agricultural extension re-invent itself? ICAR Policy Brief 16. New Delhi: Indian Council of Agricultural Research .

Swanson, B. 2009. Changing extension paradigms within a rapidly changing global economy. Paper presented at the European Seminar on Extension Education, Assisi, Italy.

Innovative extension approaches for plantation crops (2016) : 243-257
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Rubber producer societies - Extension and development arms of rubber board

Rajeevan, B.

Introduction

Transfer of technology (TOT) from technology developers to end users minimizing transmission loss needs appropriate approaches and skills. Technology diffusion enabled through identifying the pulse of the stakeholder only will end up in acceptance and adoption. The act of technology transfer and facilitating technology adoption for accomplishing the desired results is true 'extension'.

Commodity oriented extension, rural development oriented extension, technical innovation-centered or university-based extension and client-focused extension have been the extension approaches being adopted in India (Krishnakumar, 2009). Organized extension began since early 1950s in the country can be broadly classified into four phases of development. These are:(1) Extensive extension programmes (1948 to 1960) (2) Intensive extension programmes (1960-1974) (3) Research-based extension methodology programmes (1965-1979) and (4) World bank-aided projects (1974- 2000)

Extension has a pivotal role in the development process of agricultural sector, in terms of both technology transfer and human resource development. From the experience of several extension projects in India and other parts of the world and from the reports of several case studies, the significant conclusion is that the basic strategy of agricultural extension must be modified, restructured and reoriented to cater to the needs of the clientele (Samanta, 1993). It has been

universally accepted that the philosophy of extension is based on the concept of helping people to help themselves through education (Mahmud, 1986). Reorienting the extension strategy based on the real needs of the growers in a particular locality is necessary. For this, the primary requirement is a need analysis ensuring the involvement and participation of the stakeholders, i.e., a participatory approach.

Expansion of area under plantation crops, especially rubber, has been shifted from large holdings to marginal lands of resource poor farmers. Consequent to the preponderance of small and marginal growers (about 90% of the area and 93% of the production), much difficulty is experienced in disseminating technology and information on rubber cultivation. This necessitated a shift in focus and approach towards extension, i.e., change from tree-centered to holistic approach, bottom up (need-based) instead of top down approach and individual to group approach and ultimately lead to formation of true grassroots level association of rubber growers, Rubber Producers' Societies (RPS).

In India, the ratio of extension workers to small growers in Natural Rubber (NR) sector was 1:3000 (Krishnakumar and Dhanakumar, 2000) which is widened subsequently to 1: 4000. Consequently, the concentration of extension efforts in general has been in the immature phase of rubber plantations, as a major chunk of immature plantations were covered under the Rubber Plantation Development (RPD) scheme which ensured periodical visit of extension officials; in the absence of any Plan scheme to concentrate on mature area maintenance until the XI plan, practically very little support could be extended during the mature phase when critical practices such as tapping & processing, that decides the quality of the produce and marketing are taken up.

A cluster-based extension for development in agriculture through a participatory approach is the only apparent solution to address many of the issues confronting the farming sector in the country. Clusterization leads to mutual co-operation, networking and trust leading to higher efficiency and competitiveness. Participation of all sectors of the stakeholders in all activities right from the strategic planning till marketing/manufacturing is crucial in the progress and development of any industry. Pioneering in implementation of such a strategy, Rubber

Board initiated a group approach in extension in 1960s by forming taluk level marketing co-operatives. Since the taluk level forum was experienced as insufficient for reaching out to the needy resource poor rural population, village level forum of small & marginal farmers were later formed as RPS.

Rubber Producers' Societies (RPS) –Farmer participatory development initiative

RPSs are small growers voluntary institutions, which are socially-driven non-profit entities, registered under charitable societies act. The concept was coined in 1986 and in the silver jubilee year since its formation, there are over 2600 RPSs all along the rubber growing tracts of the country. The RPSs are working models of true farmer participatory development strategy successfully attempted in agriculture sector. They undertake the task of imparting technical and scientific know-how for the inclusive development of the area and in particular, for the economic and social welfare of the small growers of rubber. The RPSs form a strong institutional base for small and marginal growers at their village level, where they can collectively take up all issues directly or indirectly related to rubber. These organizations have secured a special attention amidst NR producing countries in the world as well as cultivators/promoters of other crops worldwide.

Formation of RPS

An RPS can be registered by a group of at least seven small holders by contributing Rs. 50 each as entrance fee and Rs. 10 as annual subscription and based on a model draft bye-law provided by the Rubber Board. The Board accords approval to the RPS after an inspection by the Board's field officer. Generally the field officer takes the initiative in convening and conducting sensitization seminars on the relevance of the concept in potential pockets, identifying the promoters and also assisting in the formation of the RPS. Membership is open to rubber small growers owning less than 5 ha of rubber plantation and who agree to market the rubber latex and scrap produced in their holdings through the society. Funds of the society are raised through admission fee, annual subscription, donation, loans and advance from members

and non members, subsidies and loans from other institutions including banks, co-operative societies, Rubber Board, Government etc. The ultimate authority of the society vests in its general body. The general body meeting is held periodically in a rubber holding of one of the members or at a location convenient to the member growers to reach. The management of the society is vested in the executive committee or Board of Directors (BOD) comprising the President and six members elected from the general body. The Rubber Board has the right to nominate one of its officers to the Committee and generally the field officer of the Board is nominated. The executive committee elects a vice president. The services of the president and vice president are gratuitous. The society is not authorized to appoint any persons except a (latex) collection agent (on commission basis) who may be entrusted to run the day-to-day service activities taken up by the society.

Opportunities & Strengths of RPS: RPSs are organizations with immense potential to serve for the benefit of NR sector and the stakeholders. The draft byelaw provided by the Rubber Board has provisions to address judiciously any issue related to rubber plantation industry. RPSs have the advantage to adopt a focused group approach, since the service area and the clientele number are limited. The leverage to take up activities with free technical support and partial financial assistance from Rubber Board and also to enjoy Rubber Board's credibility & guardianship offer better opportunities for RPSs to elevate their service credentials to further heights. They can nurture small activity groups under them to take up seasonal operations on a mission mode which will ultimately improve the profitability and sustainability.

Limitations of RPS concept: The main limiting factor with regard to the RPS concept is the non-remunerative status of president and executive committee members. Governing body being envisaged to offer voluntary service for hours together daily tempts youngsters with dedication to refrain from taking up the task. Dearth of working capital to widen the business base and business volume also is a bottleneck. Rare possibilities to pool huge volume to attract large players in domestic and international market which will facilitate to fetch maximum farm gate price is another limitation of RPS. Profit making competitive trading is not permissible as per the byelaw of RPS.

Activities of RPS

The RPSs have made a significant impact in the modernization process of the rubber holding sector. The prototype of the RPS was latex collection centres in rural pockets, envisaged in the pattern of 'AMUL'. Progressive development of such centres transformed the prototype to functional farmer facilitation centres. They now perform as:-

- A platform for interaction on various cultural practices and developmental activities
- Pooling centres of produce facilitating collective bargaining
- Distribution centres of plantation inputs as well as farmers' requisites
- Group processing centres of latex enabling quality up-gradation towards global competitiveness and fetching highest farm gate price
- Transfer of technology centres
- Skill development centres of rural poor farmers and other stakeholders
- Service providers by forming activity groups as Self Help Groups
- Common service centres through IT enabled services to meet farmer/stakeholder needs
- Social change agents by conducting medical camps, health care/ hygiene camps etc.

(a) Participatory Rural Appraisal (PRA) forum - With the formation of RPSs the unorganized farming community learnt to remain together, share their experience and strengthen themselves. This facilitated to formulate need-based development initiatives.

(b) Pooling Centres - Smallholders' produce when pooled together in RPSs facilitate trading in bulk and thereby to realize maximum price. Similarly, these organizations help to compute the collective requirement of inputs which enables the supplier to arrange them at a competitive price in the rural villages. Availability of required requisites at the doorsteps ensures adoption of recommended agricultural operations by the growers.

(c) Group Processing Centres (GPCs) - Infrastructure support also was provided to interested RPS which possess the required landed property for setting up facilities for processing of quality sheets from latex pooled from member producers, transforming them as Group Processing Centres (GPCs). Technical and financial assistance from Rubber Board enabled these centres to perform as models in agriculture sector. Community processing and marketing facilities set up under RPSs contributed considerably towards quality up gradation of produce and fetching the highest farm gate price (above 90%) to small and marginal rubber farmers.

(d) Transfer of Technology (TOT) centres - RPS having GPCs annexed with a training hall prove to be very effective in imparting training on various technical aspects, group management and leadership skills. These centres are provided with furniture, audio-visual equipment etc. The infrastructure facilities for technology transfer available in RPSs are used by various agencies for effective TOT.

(e) Skill-development/skill-improvement centres- To accelerate the process of empowering of RPS and ensuring devolution of extension functions to them, initially a few selected RPS (model RPSs) were supported for gearing themselves up for facilitating technology diffusion/adoption. They were provided assistance for engaging extension agents and tapping assistants to intensify extension activities under World Bank Aided Rubber Project. Training programmes (short duration training in tapping, rain guarding, processing, disease management etc.) arranged or conducted in RPSs help the resource poor population in remote villages to develop/ improve technical skills in agriculture related activities. There are 35 Model RPS and a few hundred of GPCs spread over the rubber growing tracts of the country.

(f) 'e'- Facilitation centres - To extend IT enabled services through RPSs, financial support is provided to procure computer & peripherals and also to provide training in computer use.

(g) Service providers – Many RPS maintain a labour bank (of skilled labourers, available on call) under their fold. Such RPS have

taken up the role of a service provider by undertaking jobs such as prophylactic spraying of fungicides for managing diseases and carrying out rain guarding on trees in the members' holdings on contract basis, generation of high yielding planting materials, collection of statistical data etc.

(h) Social change agents – RPSs maintain social responsibility as well. They are now instrumental in conducting medical camps, hygiene camp etc. utilizing the financial and technical support of various agencies including Rubber Board.

Further, they take up diversified charity activities such as constructing wash-room/toilet for school children (girls) in remote tribal pockets, adopting children education, etc.

RPS - mediated capacity building of stakeholders

Commitment, dedication and leadership capacity of Board of Directors (BOD) have a direct bearing on the performance level of each RPS; thus, the factors influencing the output of the BOD are identified as: personal capacity building, participation and co-operation, commitment for innovativeness and grass root level community development process, attention and skill in politics, knowledge on technical and organizational aspects, level of education, professional contacts and skill in mobilizing funds. Capacity building of BOD members through a special training programme also has been designed for strengthening RPS and about 450 delegates were trained through 32 batches at Rubber Training Institute.

The platform of RPS is being used efficiently by the extension-delivery system of Rubber Board for capacitating the end-users on availing the advantages of all latest innovations and technologies in agriculture. For example, the use of RubSiS, a farmer-friendly technology developed by the Rubber Research Institute of India (RRII) in collaboration with Indian Institute of Information Technology and Management, Kerala, National Bureau of Soil Survey and Land Use Planning, ICAR and National Remote Sensing Centre, ISRO is being taught in farmer fields under RPS. This powerful Information and Communication Technology (ICT) tool brings soil data to the fingertips of rubber growers and

recommends the optimum mix and quantities of chemical fertilizers that their holdings require, through a smart phone. Moreover, this system avoids the difficulties in collecting and testing soil and leaf samples and the additional financial burden to farmers for adopting Discriminatory Fertilizer Application (DFA).

Role of RPS in implementation of Schemes of Rubber Board

The Development and Extension schemes of Rubber Board operated at present are group centered rather than individual centered. The RPSs functioning as extension arms of Rubber Board are serving as the cutting edge with regard to implementation of these schemes. RPSs, a true farmer interest focused entity which has gained the confidence of the farming community as well as the Govt. agencies have been proved as the reliable agency for successful implementation of activities.

The first Scheme of Rubber Board, the Replanting Subsidy Scheme, launched in 1957 was continued up to 1979 with modifications brought about from time to time. It aimed at the rehabilitation of old plantations that were in a dilapidated condition due to indiscriminate exploitation during the Second World War. The scheme provided financial assistance on a graded scale to both large growers and small growers. Those owning rubber area up to 6 ha were also given additional assistance for procuring planting materials, fertilizers, cover crop seeds etc. Technical assistance also was provided, free of cost, to all those who availed of the scheme.

From 1979, the scheme for providing financial assistance, was extended for new planting also. An integrated scheme commonly known as Rubber Plantation Development (RPD) scheme for new planting as well as replanting was introduced in 1980, during the Sixth Five-Year-Plan and is still continuing in the VI phase.

Financial assistance under the RPD scheme is given as an incentive for adopting scientific cultural practices. It is released in six annual instalments based on pre-fixed performance indicators assessed by the extension officers of the Board. This system of extension service linked with financial assistance has been proved to be very effective. Studies conducted to evaluate the performance of the holdings raised

with the financial assistance and sustained extension support from the Board through RPD scheme in comparison to smallholdings raised without such support revealed that the beneficiaries of the scheme are better in the level of adoption of scientific practices in the holding, during immaturity period & thereafter as a result in the growth and productivity of the rubber trees. This is the only scheme at present operated without the direct involvement of RPS. However, the RPSs involve indirectly in arranging planting material, collecting applications, facilitating collective field verification etc.

A variety of other schemes aimed at improving agro-management, crop harvesting, processing, marketing and additional income generation from rubber holdings was implemented in the mature stage also. RPSs have a significant role in implementation of the schemes aimed at (1) productivity enhancement and (2) farmer group formation and empowerment. The following note on some important schemes implemented through the RPSs furnishes information on the service base of RPS.

1. Procurement and distribution of inputs for adoption of critical cultural practices is carried out through RPSs and companies in RPS sector. The RPSs collect the indent from their member growers, furnish the compiled requirement to Rubber Board. The Board in turn procure the materials and arrange distribution offering a price concession. The RPSs and the Companies are paid handling charges also for reaching the materials at the doorsteps of the resource poor farmer.
2. RPSs identify smallholders' fields where the advantages of adoption of critical cultural practices can be demonstrated. Technical and financial support are extended to RPSs for setting up such demonstration plots of Good Agricultural Practices at village level in farmer fields for promoting and popularizing adoption of scientific agro-management practices. The active involvement of RPSs could also demonstrate the advantage of group management in reducing cost of development and increasing the productivity.
3. Soil protection and water harvesting are the two environment friendly activities recommended in rubber plantations. RPSs play a

key role in prompting the smallholders to carry out soil protection & water harvesting practices and in certain cases arrange required labour force also.

4. Technical and financial support for farmer group formation and their empowerment are being implemented, centred at RPSs. These are monetary assistance for formation of RPS/SHG, assistance for running latex collection centre cum office etc.
5. Access to 'e'-services available in various fields is facilitated in RPSs by providing computer and peripherals. Utilizing these facilities, RPSs now perform as 'rural information hubs'.
6. Farm mechanization is promoted by extending financial support to RPSs for the purchase of weed cutters, sprayer/dusters, chainsaw etc. Since the RPSs provide service to the small and marginal resource poor farmers through the SHGs, utilizing these equipments the ultimate objective of such schemes are fulfilled.
7. A scheme to extend monetary support to small/marginal farmers in remote localities to bring their produce to Group Processing Centres or to trading centres is in operation. Successful implementation of this activity is made possible only through an entity like RPS.
8. Activities like apiculture for ancillary income generation are promoted by providing technical and financial support to activity groups under RPSs.
9. RPSs which possess suitable landed property are supported for setting up group processing centres
10. RPSs are used as a platform for conducting different types of capacity building/ training programmes for which schematic support is provided.

Rubber Board promoted companies in RPS sector

Rubber Board, an advisory body to the Govt. of India, functioning under the Rubber Act has limitations to provide the required services such as safeguarding the growers from exploitation by middle-men through market intervention for competitive marketing of the produce and also to assure uninterrupted supply of critical inputs at

reasonable rates without compromising the quality. To overcome this bottleneck, in 1990s the Board facilitated formation of private limited companies adopting the concept of agribusiness consortium, as an apex body of RPSs. These companies are formed with equity share capital participation (51%) of Rubber Board and as joint ventures of Rubber Producers' Societies [49 share = 98 %] & Rubber Board [1 share = 2 %].

Rubber processing and marketing involves high technology and investment. The RPSs by themselves could not ensure such infrastructure development. To support the RPS for this cause, the companies initiated setting up of processing factories and taking up trading of latex, sheet rubber, field coagulum and agro inputs. This initiative led to quality improvement significantly and in turn substantially towards export of NR and also to realize a premium price for their produce.

There are now 6 processing companies and 12 trading companies operating for the service of rubber growers. Diversified activities such as plantation development and maintenance on contract are also being taken up by these companies.

During the silver jubilee year since formation, the companies as part of diversification have shifted their focus from trading/processing to promote the concept of 'agri-business company, facilitator and service provider'. The companies are now envisaged as 'event managers' in agriculture sector.

Farmer Facilitation Centres (FFC) of Companies: Companies operate FFCs attached to RPSs so as to provide need-based service support to resource poor farmers. In addition to advisory support and material support coupled with financial support through Government schemes, the dearth in adoption of scientific plantation management practices in rubber plantations is found increasing alarmingly in the recent years. A large extent of plantations is even kept untapped (not harvested) due to varying reasons. All these lead to decline in productivity and production, which is a national loss.

The FFCs of companies offer technology adoption support for plantation management and harvesting/processing/marketing support to enable

enhancing production and productivity. This is introduced with a view to see that proper yield is realized from all plantations which attained productive stage. The strategy is to take up all jobs related to plantation maintenance by the company through the FFC under a MoU with the concerned grower. The net profit will be remitted to the account of the plantation owner periodically and a nominal service charge only be levied from the grower. This package envisages an attractive sustainable income to the planter and estimated production of NR.

Impact of RPS on participatory smallholder development - An analysis

The extension strategy proposed by the Board is devolution of extension functions by involvement of the RPS in a phased manner. Therefore, it is imperative that this grass roots level institution works more effectively. In a study conducted in 29 villages in a predominantly rubber growing tract in India (Krishnakumar and Nair, 1999) it was observed that 33.14 % of the growers are members of the RPS and on an average there are 3 RPS per village. It was reported by 27% of the growers that they have been getting technical information from the RPS. On an evaluation of the general performance of the RPS it was however noticed that only 30% of them were functioning satisfactorily. In yet another assessment study by National Institute of Agricultural Extension Management (MANAGE), the role of RPS was observed to be significant in the development process.

Another assessment of the performance of the RPS (Krishnakumar and Dhanakumar, 2000) analyzed the organizational structure and management procedure of RPS, constraints hampering their performance and impact of the RPS including analysis of the factors responsible for their success. The study revealed that the RPS need more technical back up and human resource development. For effective functioning, there was a need for increasing competence of the BOD. Though many of them possess technical skill to manage their own plantations, their skill in managerial and human resource dimensions was very limited.

The study based on a detailed factor analysis on the Board of Directors

of RPS revealed the impact of efficient functioning of RPS on increasing production, improving the quality of life and disseminating information on issues related to rubber cultivation. In the good RPS 70% of members attained high production, 56.7% improved their quality of life and more than 80% paid attention to issues related to rubber whereas in the poorly performing RPS these values were 26.3, 10 and 15 per cent respectively. The major factors which prompted participation in RPS were access to technical information, need for group activity through RPS and direct financial benefits, the corresponding weightage being 46, 35 and 28 per cent respectively.

On an average, only 25 to 30% of the small growers are members of the RPS. In yet another study conducted by the Centre for Management Development (CMD) Thiruvananthapuram, the reasons for the poor membership has been identified. Some farmers (50%) regarded membership in RPS as not worthwhile while some other (21.5%) were not aware of its activities. Some farmers (16.25%) could not become members as no RPS is functioning nearby while a few (7.5%) was not pleased with the way in which the nearby RPS functions. Only 5% farmers indicated financial constraints as reasons for non-membership. The study also revealed that 4.86% of the total rubber produced only was channelized through cooperatives. However, the RPS had a profound influence in ensuring adoption of technology. Of the samples of RPS members studied 46.92% adopted discriminatory fertilizer recommendation whereas it was only 8% for non-members.

Conclusion

Rubber Board's extension system had pioneered different approaches to implement development and extension schemes through technical support, infrastructure support and strengthening supply chain mechanism, in a most unique manner. Of these the smallholder empowerment approach adopting a cluster-based and community driven development through formation and institutionalization of RPSs was a milestone towards the progress and development of the NR sector. RPSs are causal for the significant improvements in the sector such as achieving cost competitiveness, quality up gradation, adoption of GAP as well as capacity building of rural poor. These farmer clusters

thus function as effective extension arms of Rubber Board. Formation and promotion of companies in RPS sector with the vertical integration of RPSs initiated a market led extension service enabling collective and competitive marketing. The result of the productive use of these concepts is reflected in excellent outcomes such as 100% adoption of High Yielding Varieties, attaining the highest productivity among NR producing countries in the world, securing the highest farm gate price (above 90%) for the produce to rubber growers even in remote localities, nurturing leadership skills among resource-poor farmers etc.

Introduction of an innovation systems perspective to the existing RPS-based extension system will facilitate improved access of farmers for innovative interaction with partners in research, education, agribusiness and other relevant institutions. It is proposed with a view to equip the RPSs to contribute towards accomplishing Board's vision document where a change in priorities from (a) self-sufficiency to global competitiveness (b) productivity to profitability (c) import substitution to export promotion and (d) domestic market orientation to global market orientation are envisaged. Further, RPSs have a pivotal role for bringing in professionalism in agriculture and agricultural extension which is needed to attract new generation to agriculture.

References

Krishnakumar, A.K. 2009. Trends in Agricultural Extension in 'Towards Inclusive Development' (Ed. C. Kurivila Jacob) Rubber Board, India. pp. 24-30

Krishnakumar A.K. and Dhanakumar V.G. 2000. An Assessment of Rubber Producers' Societies, (Self Help Groups of Small Growers) in Rubber Plantation Sector in India. "Plantation tree crops in the new millennium". Proceedings Indian Planters' Conference, 17-20 May 2000, pp. 491-502

Krishnakumar, A.K. and Nair, P.M.M. 1999. Technology Transfer an Indian Experience. Paper presented at the International Seminar on Modernization Rubber Smallholding Sector – ANRPC, July 1997, Pedang, Indonesia.

Mahmud, D. A. B. 1987. Extension in Action: Malaysian Experience.

Proceedings of Seminar on Trends in Agricultural Research and Extension in Developing Countries, (Eds. A.P.Zainudeen et.al.,) 27-29 Nov. 1986, Kuala Lumpur Agricultural Institute of Malaysia, Kuala Lumpur, pp.126.

Samanta, R.K. 1993. Extension Strategy for Agricultural Development in 21st Century. Mittal Publication, New Delhi, pp.1-5

Innovative extension approaches for plantation crops (2016) : 258-267
Editors: Thamban, C., Jaganathan, D., Kalavathi, S., Anithakumari, P., Chandran, K.P. & Jayasekhar, S.
ICAR-Central Plantation Crops Research Institute, Kasaragod 671124, India

Evolution, status and roadmap for extension strategies in commercial plantation crops: The case of tea

Lijo Thomas

Introduction

The term 'plantation crops' refers to 'commercial crops' which are cultivated on an extensive scale in contiguous area. Tea is an important plantation crop in the country. Tea is an evergreen plant that mainly grows in tropical and subtropical climates. It is thought to have originated in East Asia somewhere between China and Burma. Commercial cultivation of tea started in India during the British era after the discovery of wild tea plants in Upper Brahmaputra in 1823 by Robert Bruce. The tea varieties from India have achieved global acclaim due to their distinct characteristics. The initial tea plantations were established by the British in Darjeeling and Assam and the commercial success of the venture prompted them to establish tea plantations in other areas of the country with suitable agro-ecological conditions. Blessed with diverse agro climatic conditions, India produces a wide variety of tea, including CTC tea, orthodox tea, green tea and organic tea. Unlike most other tea producing and exporting countries, India has a manufacturing base for both CTC and orthodox tea, in addition to green tea. The capacity to cultivate high-quality specialty teas such as Darjeeling, Assam orthodox, high-range Nilgiri, etc., all of which possess distinctive aromas, strengths, colours and flavours. The accumulated collective experience of more than 150 years in commercial tea cultivation in India is one of the major strengths of Indian tea industry. In India, tea is primarily cultivated in the hills of North-eastern and Southern states.

Production profile

India has emerged as the second largest producer, fourth largest exporter and largest consumer of tea globally. During 2014-15, tea was grown in 563.98 thousand hectares with a total production of around 1197.18 million kg. Of this, around 80 per cent of the production came from North India and the remaining 20 per cent was produced in South India. The country also consumed 911 million kg of tea during this period. India is ranked fourth in terms of tea exports, which reached 197.81 million kg during 2014-15 and were valued at US$ 619.96 million. The top export markets in volume terms for 2014-15 were Russian Federation (39.14 million kg), UK (18.58 million kg) and Iran (17.53 million kg). India has a significant share in the international tea market with a 12 per cent share of world tea exports in 2013-14.

Assam alone accounts for 54.2 per cent of the total area under tea in the country. West Bengal (24.8 per cent), Tamil Nadu (12.3 per cent) and Kerala (6.2 per cent) are the other significant tea producing states in the country (Table 1). Although tea is grown in 16 states, Assam, West Bengal, Tamil Nadu, and Kerala account for about 95 per cent of total tea production. Tea is also produced in small scale in States like Tripura, Karnataka, Himachal Pradesh, Bihar, Uttarakhand & all the other N.E. states viz., Arunachal Pradesh, Manipur, Meghalaya, Nagaland, Mizoram, Sikkim. The tea plantation sector along with the tea industries employ over 3.5 million people with a significant number of women labourers.

Table 1: Area and production of tea in India (2015-16)

State / Districts	Area ('000 ha)	Production (Million Kgs)
Assam	307.08	652.95
West Bengal	140.44	329.70
Other North Indian States*	12.29	25.91
Total North India	459.81	1008.56
Tamil Nadu	69.62	161.46
Kerala	35.01	56.63

Karnataka	2.22	6.46
Total south India	106.85	224.58
Total	566.66	1233.14

Source: Tea Board

* Includes Tripura, Uttarakhand, Bihar, Manipur, Arunachal Pradesh, Himachal Pradesh, Nagaland, Meghalaya, Mizoram and Sikkim

The large holdings account for nearly 80 per cent of the area and production of tea in India. The skewed nature of ownership of tea gardens holds significance for extension efforts in the sector. The report on the tea Industry submitted by the Parliamentary Committee on Tea, Rajyasabha in 2003 classified tea holdings on the basis of area under management and the ownership pattern. Accordingly the tea estates can be broadly classified under the following heads.

- Small holdings, with tea area of less than twenty-five acres, owned by the proprietors
- Small gardens, with tea area below 200 ha, owned by a single proprietor or partnership firms
- Estates owned by limited liability companies: Public Limited companies and Private Limited Companies
- Estates owned by big companies
- Estates owned by government undertakings and co-operatives.

At the national level the large estates which form only less than 2 per cent of the total number of holdings own more than 80 per cent of the area under the crop. The production scenario also reflects a similar skewed pattern.

Trends in area, production and productivity

The tea plantation sector has witnessed more or less steady growth, both in terms of production and productivity. The production of tea which was 354 million kg for the triennium ending 1960-61 increased to 2071 million kg by 2014-15. Though the area under the crop has increased, the increased production was mainly achieved through enhanced productivity. The area, production and productivity of the crop during the last six decades are presented in Table 2.

Table 2. Area production and productivity of tea

Period	Area ('000 ha)	Production (million kg)	Yield (kg/ ha)
TE 1960-61	331	354	1070
TE 1970-71	356	416	1166
TE 1980-81	381	558	1462
TE 1990-91	417	703	1687
TE 2000-01	489	849	1737
TE 2010-11	586	977	1668
TE 2015-16	567	1233	2175

Tea research and development in India

Historically, institutional research activities in tea have been privately managed in the country particularly in two major tea research institutes The Tocklai Experimental station (recently renamed as Tocklai Tea Research Institute) of Tea Research Association was started at Jorhat in the year 1911. The institute has a special focus on Northern and North Eastern states and is funded by tea industries through the member contributions and by the Ministry of commerce, Government of India. Apart from its research mandates, transfer of technology to its member estates is carried out through its advisory network covering 1076 tea estates occupying 3,41,049 ha of land spread over The South Bank, North Bank, Upper Assam, Cachar, Tripura, Dooars, Darjeeling and Terai.

In South India, tea research is mainly coordinated and carried out by the UPASI Tea Research Foundation (UPASI TRF), which had its origin as Tea experimental station at Gudalur in 1926. The institute receives research funding from Ministry of Commerce and through membership contributions of the members. The institute also provides extension services to the tea estates in the region. Research on the crop is also carried out in many agricultural universities on a limited scale with specific objectives, which are usually short term in nature. The Tea Board also has a Research and Development Centre (Darjeeling Tea Research and Development Centre) at Kurseong to undertake

research on issues which are specific to tea plantations in Darjeeling area. (Tea Board has a broad mandate as far as the development of the sector is concerned. A brief examination of the activities of the institutions involved in tea research shows that the extension activities have always gone hand in hand with research activities. In plantation crops like tea, the role and relevance of extension services cannot be compartmentalized from research functions.

Evolution of extension services in tea

A close examination of the history of the institutions involved in the development of the tea plantation sector brings out certain commonalities and shared history in the evolution of extension services offered to the tea plantation sector. An understanding of this evolving nature of extension services is essential for developing a futuristic vision for extension services in the tea plantation sector.

The tea plantations have a history of more than 150 years of existence. Obviously, the initial extension efforts following the establishment of tea plantations were mainly directed at spreading awareness about the crop with respect to its basic cultivation practices and agronomic management. The plantation method of raising tea crop was also relatively new in the country and this also necessitated focused intervention for adoption of this model for the crop. The extension efforts were not organized or coherent in the initials decades and slowly, with the establishment of plantations, a structured approach in extension activities gained currency.

The initial delivery of extension services were mainly of advisory nature which followed the visits to the newly formed estates and the extension advisories were given by experts in botany. The flourishing number of tea plantations soon started demanding extension services and it is though that a rare situation of demand driven extension service was in vogue towards the end of 19th century and early part of 20th century. The initial institutional efforts in development of the tea plantation sector therefore also gave adequate attention to provision of extension services to the plantations, both members and the non members. The scientific personnel working in these institutions were also part of

the extension efforts and a significant time of these personnel were devoted towards extension service delivery function. Separate advisory service section/ departments evolved in these institutions further strengthening the extension service delivery in the crop sector.

The planters associations and other organizations with diverse membership criteria evolved in the major tea plantation areas and these associations/clubs served as a medium of dissemination technical information about the crop. The informal discussions and sharing of information promoted by these associations strengthened the farmers to farmer mode of information spread and technology adoption. The elements of this evolutionary trend in extension service delivery in the crop sector can be seen in the present extension network in place for the crop.

Current Scenario and role of extension services in tea

The tea plantation sector is characterized by the high degree of dependence of local population on tea plantations for livelihood security in major tea growing regions. Apart from this, the highly organized nature of production, predominance of large holdings, the peculiarities related to processing and marketing all make tea plantations a unique sector. The role and relevance of extension services in such a scenario is different from the typical supply driven extension approach in vogue as in the case of field crops in the country.

The extant extension service delivery mechanism in tea sector is mainly through field visits, participatory extension activities, release of advisories through mass media, trainings, crop clinics and information dissemination services through printed material and ICT enabled communication channels. Each of these approaches has a set of parameters which works in its favour with respect to tea plantations. The emerging trend in the extension service delivery is the increased use of participatory activities with the research system involving the stakeholders. The development of extension teaching materials has seen a seismic change with the use of innovative concepts like voice based e- extension systems, mobile linked extension services, enhanced use of multimedia etc.

The extension services in the tea plantation sector have focused on the estate production system due to the high share of large holdings in the area under the crop. This has lead to a extension research vacuum with respect to the extension strategies to be adopted for the small holder producers of tea. Recent initiatives by extension delivery agencies in the tea sector indicate an attempt to correct this historical imbalance with respect to extension services. The requirements and the strategies to reach out to the small holder producers in tea are considerably different and this realization has increasingly lead to deployment of special schemes for development of small holdings and for delivery of extension services to them. Though the developmental schemes with special focus on small holders have been well established, the same cannot be said about the extension service delivery. The high cost of extension service delivery for the disaggregated small holder producers reduces the efficiency of the extension mechanism. Alternative models of extension service delivery need to be explored which can reduce the cost of service delivery and enhance the efficacy of the service.

Priority areas for extension service in tea

Extension services reach out to farmers to help boost the speed of technology adoption. The technology adoption is a continuous process with new technologies replacing the existing ones. Therefore the extension services retain a continued relevance in the tea plantation sector. The emerging challenges of climate change with the need for maintaining a sustainable production system and the urgent attention for conservation of resources has brought forward many issues before the research community. The technological solutions to these challenges need to be disseminated among the large tea gardens as well as the small holdings to create an economically viable and environmentally sustainable tea economy in the country. The large holdings in the tea sector need to slowly shift towards a paid extension service model. This will require considerable policy prescription and handholding. This will increase the resources for better focus on small holders, which can create a significant positive impact on the farm business income in small holder production of tea. The major focus area of extension services in the small holder tea sector revolves around the following aspects.

- Focus on skills and knowledge related to water management
- Integrated disease management
- Organic production of tea
- Effective organization of farmers to form farmer interest groups, producer companies etc.
- Integrated foliar nutrient management for higher productivity
- Drought management
- Mechanized harvesting
- Specialty tea production techniques
- Value addition in tea and its products
- Farm records management for efficient estate management by small holders
- Rejuvenation/replanting in low productivity regions

Extension service in tea: Future directions

The tea economy of the country faces numerous challenges. This is clearly seen from the recent events of closing of many tea plantations across the country and the continuing dissatisfaction among the labourers in the tea plantation sector. The profitability of commercial tea cultivation has seen a decline and the ability of the sector to invent creative responses to adapt to the evolving economic and market scenarios will determine it viability as a key sector in the economy of the country. The extension services in the sector also need to evolve simultaneously to offer creative solutions for the challenges faced by the sector. Some of the key elements for futuristic extension approach for tea plantation sector are outlined below.

- Use of appropriate extension strategies can address some of the challenges faced by the tea plantation sector including the economic downturn in the sector through critical technology gap identification and its mitigation.
- There is a need to integrate extension and social research to develop a comprehensive understanding of the tea plantation sector. This is essential to fine tune extension strategies since the employ-employer relationship and the diverse social impact dimensions

of tea plantation enterprise needs to be integrated in extension strategies.

- Develop functional and need based training modules for various identified priority areas selected for technology dissemination. These programmes should also have elements of skill development as an essential content.
- Enhance the role of participatory decision making process in identifying research needs to generate highly relevant technology component for fast adoption. Participatory approach should also be adopted for technology development and technology dissemination process.
- Create a farmer research linkage programme with a strong focus on collaborative extension research to address specific issues faced by the tea plantation sector.
- Experimenting with diverse extension service delivery models including fee based consultancies for addressing resource constraints, strengthen demand based extension services and create a sense of accountability in delivery of professional service. Extension service delivery models suited for small farmer groups likes FIGs and SHGs need to be fine tuned.
- Establishing a pluralistic extension approach harnessing the synergies of diverse channels and approaches for extension service delivery. This requires strengthening the online information delivery, creating a network of Information Centers, exploring the possibilities of e-learning, creative use of mass media, exploiting the potential of satellite television for niche areas and fine tuning the extension content delivery to address the specific groups of tea growers on region specific issues.
- Extension efforts should also address the issues in marketing of the produce through introduction of innovative use of concepts like social marketing, specialty niche markets, private branding etc.
- The latent potential of tea plantation sector can be realized through creative interventions in the developmental policy making, enhanced extension efficiency, favourable market policies and trade

support. The country needs to leverage the full benefits of the untapped potential offered by the use of geographical indicators in specialty tea production for creating, expanding and deepening the consumer preference for Indian tea products. The GI portfolio in tea can be further strengthened through region wise profiling of tea products for quality parameters. The coordinated efforts in all the spheres of tea production, processing extension and marketing can reap rich dividends for the tea economy as a whole.

References

Chen, Liang.,Apostolides, Zeno and Chen, Zong-Mao. 2012. Global Tea Breeding: Achievements, Challenges and Perspectives. Zhejiang University Press

Farrington, John. 2002. Recent and future challenges in agricultural extension. Low External input Sustainable Agriculture magazine, 18(2), July, 2002.

Government of India. 2015. Economic Survey 2014-15, Oxford University Press, New Delhi

Rasaily, Rinju. 2014. Women labour in tea sector: Changing trajectories and emerging challenges. NRPPD Discussion paper no. 31. Centre for Development Studies, Thiruvananthapuram, pp 58.

Sidhakaran, V. S. 2012. Scope of Private Extension for the Corporate Sector Tea Plantations: Clientele Perspectives. Sri Lanka Journal of Tea Science, 77(1/2): 83-102.

www.teaboard.gov.in

www.indiantea.org

www.upasi.org

List of contributors

Anithakumari, P.
ICAR - Central Plantation Crops Research Institute, Regional Station, Kayamkulam, Alappuzha

Berin Pathrose
Krishi Vigyan Kendra, Kerala Agricultural University, Malappuram

Chandran, K. P.
ICAR - Central Plantation Crops Research Institute, Kasaragod

Jaganathan, D.
ICAR - Central Plantation Crops Research Institute, Kasaragod, Kerala

Jayasekhar, S.
ICAR - Central Plantation Crops Research Institute, Kasaragod

Jnanadevan, R.
Coconut Development Board, Kochi

Jose, C.T.
ICAR - Central Plantation Crops Research Institute, Regional Station, Vittal, Karnataka

Kalavathi, S.
ICAR - Central Plantation Crops Research Institute, Regional Station, Kayamkulam, Alappuzha

Kunhammad Master, M.
Chairman, SUBICSHA, Kozhikode, Kerala

Lijo Thomas
ICAR - Indian Institute of Spices Research, Kozhikode, Kerala

Mary Rani, K. L.
ICAR - Indian Institute of Oil Palm Research, Pedavegi, Andhra Pradesh

Nagaraja, N. R.
ICAR - Central Plantation Crops Research Institute, Regional Station, Vittal, Karnataka

Nija George
Krishi Vigyan Kendra, Kerala Agricultural University, Malappuram

Prakash, P.
ICAR - Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram

Prasad, M. V.
ICAR - Indian Institute of Oil Palm Research, Pedavegi, Andhra Pradesh

Rajeev, P.
ICAR - Indian Institute of Spices Research, Kozhikode, Kerala

Rajeevan, B.
Managing Director, M/s. Manimalayar Rubbers Pvt. Ltd., Rubber Board, Kottayam, Kerala

Rajkumar
ICAR - Central Plantation Crops Research Institute, Kasaragod, Kerala

Ramachandran, C.
ICAR - Central Marine Fisheries Research Institute, Kochi

Sairam, C. V.
ICAR - Central Institute of Brackish water Aquaculture, Chennai

Sajeev, M. V.
ICAR - Directorate of Cashew Research, Darbe, Puttur, Dakshina kannad, Karnataka

Sakeer Husain, A.
Centre for e-Learning, Kerala Agricultural University, Thrissur

Sheela Immanuel
ICAR - Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram

Sivakumar, P. S.
ICAR - Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram

Sreenath Dixit
ICAR - Agricultural Technology Application Research Institute, Bengaluru

Sunil, V. G.
Krishi Vigyan Kendra, Kerala Agricultural University, Malappuram

Thamban, C.
ICAR - Central Plantation Crops Research Institute, Kasaragod

भाकृअनुप
ICAR

ICAR - Central Plantation Crops Research Institute
Kasaragod 671 124, Kerala, India

केरोफअसं
CPCRI