Technical Bulletin: 98

Centenary Publication-18

Community based extension mechanisms for pest and disease management of coconut

Success stories

भाकृअनुप - केन्द्रीय रोपण फसल अनुसंधान संस्थान
कासरगोड़, केरल - 671 124, भारत

ICAR-Central Plantation Crops Research Institute
Kasaragod – 671 124, Kerala, India
www.cpcri.gov.in

Technical Bulletin: 98

Centenary Publication-18

COMMUNITY BASED EXTENSION MECHANISMS FOR PEST AND DISEASE MANAGEMENT OF COCONUT

SUCCESS STORIES

भाकृअनुप - केन्द्रीय रोपण फसल अनुसंधान संस्थान
कासरगोड़, केरल - 671 124, भारत
ICAR-Central Plantation Crops Research Institute
Kasaragod – 671 124, Kerala, India
www.cpcri.gov.in

ICAR – CPCRI Technical Bulletin No. 98

Published by

P.Chowdappa

Director, ICAR-Central Plantation Crops Research Institute

Kudlu P.O.,Kasaragod -671124, Kerala

E-mail: director.cpcri@icar.gov.in

Website : www.cpcri.gov.in

Compiled and edited by

Anithakumari. P

Muralidharan. K

Chandrika Mohan

Krishnakumar. V

Chowdappa. P

September 2016

Community based extension mechanisms for pest and disease management of coconut - Success stories

Success stories of community based extension mechanisms for management of pest and disease of coconut

Coconut (*Cocos nucifera* Linn.) is considered as one of the most versatile and environmentally benign crops, providing food, beverage, fuel, wood and bio energy. The crop provides nutritional support to farm families thus contributing to the nutritional security of the coconut growing areas. Coconut is cultivated in 93 countries in an area of 12.61 million hectares and the production during 2013 was 61.08 billion nuts. India, the second largest producer of coconut in the world, produced 15729.7 million nuts in the year 2013 from an area of 18.95 lakh hectares spread across 18 states and 3 Union Territories. Out of 5 million coconut holdings in the country, 98 per cent are below 2 ha in size and 3.5 million holdings belongs to the state of Kerala.

Infestation of pests and diseases is the most cited production constraint of the crop. The pests and diseases could affect all growing stages of coconut causing direct and indirect losses.

The major pest of coconut, which is reportedly present in all coconut growing areas in the country, is the black beetle or Rhinoceros beetle. Besides causing direct damage, its infestation also accelerates the incidence of red weevil as well as bud rot disease; both often are fatal to the coconut palm. Hence this pest attains importance in terms of its infestation at seedling, juvenile and bearing stages. It was reported that the pest could cause 10 per cent yield loss in bearing palms.

The Integrated Pest Management (IPM) of Rhinoceros beetle includes prophylactic leaf axil filling and use of bio-control agents. While components of IPM was observed to be adopted by 36 per cent of coconut farmers, knowledge and adoption of bio-control methods were reported only from less than 5 per cent of the coconut holdings. It was also reported that non-availability of bio-control inputs is the most stated constraint with regard to adoption. One of the most effective bio-control agents against rhinoceros beetle is *Metarhizium anisopliae* (Metsch.). But even after three decades, the diffusion rate of this technology was very low. It thus makes sense to conclude that the conventional extension approach failed to disseminate this technology among coconut farmers mainly due to the lack of efforts in making the bio control agent available to the farming community. Alternative approaches are therefore to be evolved for effective utilization of this research finding for the benefit of coconut farmers. ICAR- CPCRI evolved technology specific extension delivery mechanisms to suit the social, economic and situational resources and to improve the technology dissemination and utilization among the stakeholders. Extension mechanisms for managing field problems of coconut- a plantation crop needs special emphasis, while considering the following factors.

- Coconut, a perennial plantation crop, being cultivated in contiguous area provides congenial conditions for pest and disease incidences throughout the year. The crop is also cultivated in small and marginal land holdings (average holding size of 0.2 ha) raising the challenge of 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 the characteristics of the technology.
- Technologies may not be disseminated or motivated for utilization in field situations without appropriate extension mechanisms. 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 factors, social components, economic factors and bio physical constraints in lowering technology utilization, requires attention for evolving extension approaches or mechanisms. Study by ICAR-CPCRI on constraint analysis in technology utilization among coconut farmers of root (wilt) disease affected areas indicated that technical/ extension constraints were one of the major constraints (figure 1).
- Extension approaches/ mechanisms need paradigm shift from targeting individual farmers to area wide or groups/community based approches for improving

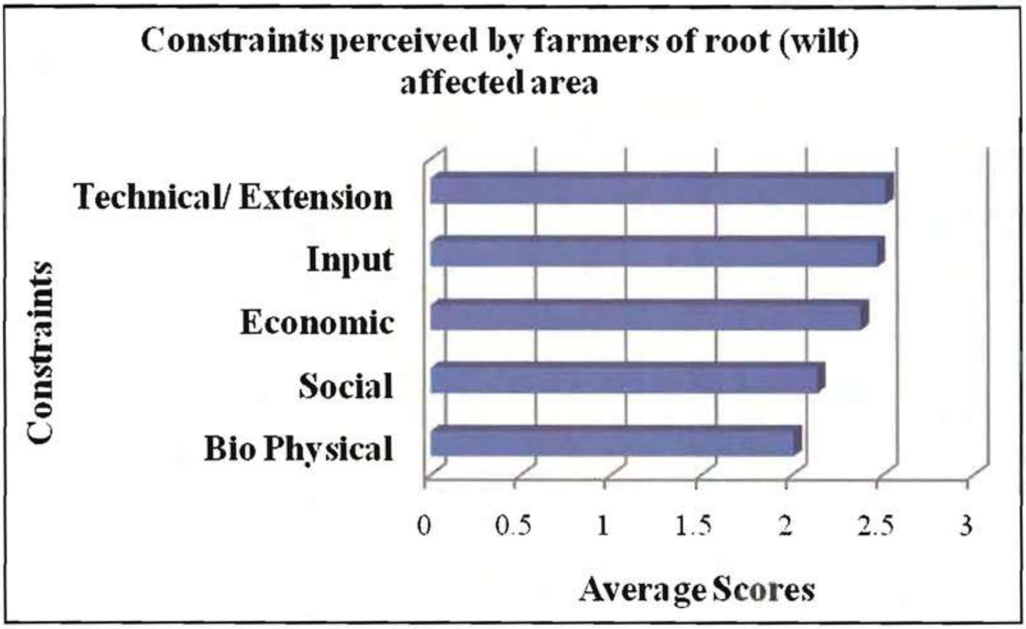


Figure 1. Broad areas of constraints perceived by farmers of root (wilt) affected area (n=155)

efficiency as per the field situation analysis and documentation.

- Time, cost, impact, economic/ environment benefits and resource use efficiency could be achieved through linkages, appropriate technology choices, participatory approaches and implementation.

ICAR- CPCRI evolved extension mechanisms for management of root (wilt) disease of coconut, biomanagement of rhinoceros beetle and is in the process of continuing the efforts for management of other pests and diseases as well for the wide spread awareness on the implementation of extension mechanisms.

Participatory Technology Transfer Approach (PTTA) for coconut root (wilt) disease management

The pilot project for evolving contiguous area of root (wilt) disease management was taken up in 25 hectare area around the ICAR- CPCRI, Regional Station, Kayamkulam. The total number of households were 200, with an average land holding size of 0.12 ha, adopting rainfed cultivation in coconut based homesteads. Sixty six per cent of the households was 0.1 ha and 27 per cent above 0.4 ha. Number of adult coconut palms in the area was 5000 and young coconut palms were 2000.

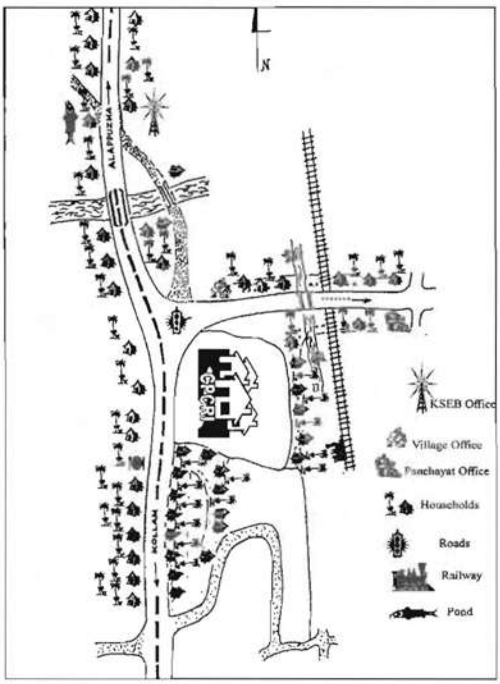


Figure 2. Social map of the project area (25 ha) – Krishnapuram gramapanchayath, Alappuzha district

The package of practices followed in the project were nutrient management-Application of 1/3 dose of fertilizers during May – June, 2/3 during August – September, basin management, lime application, sowing of green manure crops in April-May and incorporating at the time of flowering, adoption of plant protection measures against leaf rot and other insect pests and mites.

The extension approach adopted was participatory technology transfer involving relevant stakeholders. The components adopted are as follows:

The PTT approach is a continuous social process getting evolved gradually to suit the situations and targets of technology adoption. Hence it requires adaptations and refinement based on locations.

Adoption of integrated root (wilt) disease management practices by community of farmers (contiguous area) enables triangulation among the participant farmers regarding the technology effectiveness and field based representative impact on the disease reduction. The Table 2. indicates the reduction in disease index (improvement of health of root (wilt) disease affected palms) reflecting the role of integrated management.

The reduction of disease advanced palms was also due to the removal of disease advanced palms yielding less than 10 nuts per palm per year.

Root (wilt) disease affected palms are categorized as apparently healthy, disease early, disease middle and disease advanced according to the scores based on the symptoms of flaccidity (F), yellowing (Y) and necrosis (N). The disease index is calculated by dividing the sum of total grade points obtained for flaccidity (0-5), yellowing (0-3) and necrosis (0-2) by the total number of leaves. The palms are categorized accordingly and the total percentage calculated. The

Coconut farmers' gardens after adoption of integrated root (wilt) disease management

Leaf rot disease- recovered palm

Improved cropping intensity and basin management

Table 1. Participatory Technology Transfer (PTT)

Implementation phases	PTT methods utilized	Groups involved
Rapport Building/ Dialogue Stakeholder analysis	Scientist farmer interaction Bench mark survey of farmers and palms	Research group/First line extension/farmer groups
Participatory assessment of farming situations	Conducting PRA	Research/extension/ farmer groups.
Technology transfer	Result demonstration of root (wilt) management practices Method demonstration/ training programmes (need based)	First line extension/ extension/farmer / women groups
Technology implementation	Adoption of practices in discussion with and involvement of participant farmers/women or whole family members	First line extension/ farmer /women groups
Monitoring and follow up	Informal interviews and data collection Keeping activity charts/diaries with the participant farmers	First line extension/ farmer /women groups
Participatory evaluation	PRA / Survey of farmers	First line extension/ extension/farmer / women groups

integrated management practices could reduce the disease intensity and improve the productivity of root (wilt) disease affected palms. Table 2. clearly shows improvement of apparently healthy palms by 49, disease early by 1.8 and disease middle by 10.82 per cent respectively over the pre project data and 66.8 per cent reduction in disease advanced palms over the pre project data primarily due to removal of disease advanced palms and health improvement.

The yield gap documented in farmers' fields presented wide variation from field to field. Based on the actual yield data of palms in the project areas, the palms were categorized in discussion with the participant farmers, as started flowering, very low yielding (<10 nuts/

Table 2. Impact of Participatory Technology Transfer Approach (PTTA)

Root(wilt) disease intensity category	Pre intervention [palms (%)]	During intervention [palms (%)]	Post intervention [palms (%)]
Disease Advanced (DA)	23.5	14.4	7.8
Disease Middle (DM)	32.2	27.9	35.7
Disease Early (DE)	31.7	41.0	37.7
Apparently Healthy (AH)	12.6	16.7	18.8

Table 3. Impact on yield due to management practices

Yield categorization by farmers (nuts/palm/year)	Pre-project (1999) (% of palms)	Post-project (2003) (% of palms)
Started flowering	2.0	2.2
Very low (<10)	6.5	4.3
Low (10-20)	26.0	13.6
Medium (21-50)	19.0	31.3
High (>50)	7.5	20.7

year), low (10-20 nuts/year), medium (21-50 nuts/year) and high (>50 nuts/year).

The data in Table 3. and Table 4. clearly shows the impact of integrated management package for root (wilt) disease in improving the yield of disease affected palms. This data attains particular emphasis since adoption of management practices offers the best option for reducing the yield gap and realizing income from coconut palms. The three fold increase in the number of high yielding palms of the project area indicated the potential for bridging yield gap and the utility of research recommendation in farmers' fields.

The awareness, knowledge and adoption indices of the coconut farmers regarding the integrated management practices for root (wilt) disease were calculated by dividing the total awareness/knowledge/adoption of the respondent with maximum scores and multiplying by 100. An attitude scale was constructed for the purpose and accordingly attitude of farmers regarding the agreement or disagreement in a three point continuum was calculated. The awareness, knowledge and attitude

Table 4. Impact of integrated management on coconut productivity

Yield	Pre-project 1999	Mid-project period 2001	Post project 2003
Average (nuts/palm/ year)	24	32 (34.3 %)	46 (91.4 %)
BC Ratio	1.03	1.18	1.77

(In bracket improvement of mean yield of root (wilt) diseased palms)

Table 5. Impact on awareness, knowledge, attitude & adoption (n=200)

Variables	Average scores of respondents		't' value
	Before PTT	After PTT	
Awareness	14.11	32.53	14.3452**
Knowledge	18.84	59.47	08.0527**
Attitude	22.56	36.48	04.3811**
Adoption	16.32	45.58	06.8981**

** Significant at 1 % level

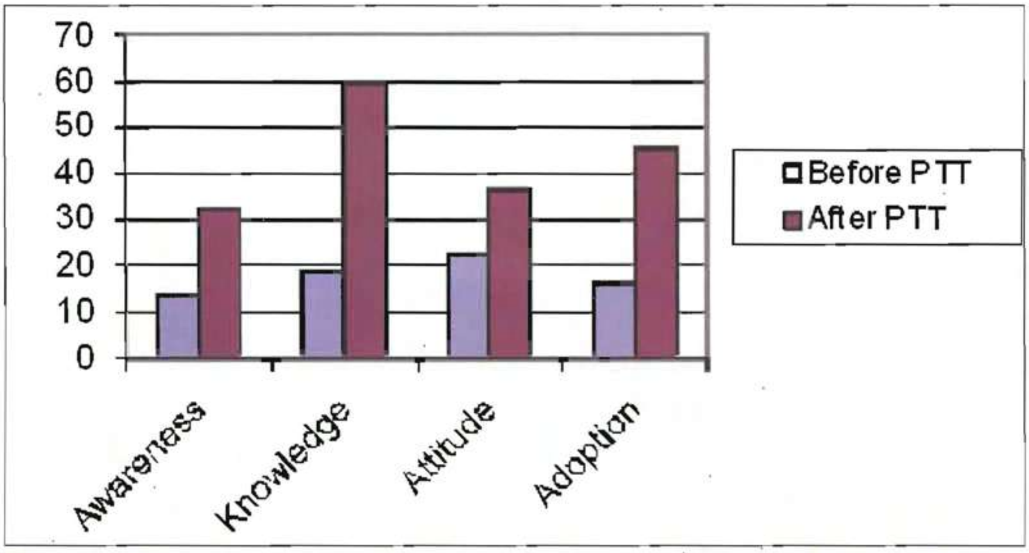


Figure 3. Improvement in awareness, knowledge, attitude and adoption due to PTT (%)

of the participant farmers was found to be significantly improved after the participatory technology transfer approach, showing the appropriateness of the approach and social process (Table 5. and Figure 3).

The data in Table 6 indicates that maximum improvement was recorded in the integrated disease management of coconut which are the critical technologies in integrated root (wilt) disease management. The utility of the PTT approach was amply evident from the data.

Interface programmes and Participatory Rural Appraisal (PRA) were conducted with participating farmers, extension officials and CPCRI scientists. The farmers recorded 60 per cent recovery of leaf rot affected palms and yield improvement up to 60 per cent. They also opined that awareness about research findings and the process improved and the participatory components increased. The observable results recorded were increase in copra content (quality improvement), reduction in yellowing and greenish appearance of palms, exchange of ideas and information among farmers and general improvement in health and vigour of palms.

The root (wilt) disease of coconut was demonstrated in participatory mode as a manageable disease to bridge the gap in productivity and income from coconut.

Table 6.Practice wise gain in awareness, knowledge and adoption of integrated root (wilt) disease management after PTT (n=200)

Technologies	Improvement (%)		
	Awareness	Knowledge	Adoption
Nursery management practices	26.40	34.23	35.40
Planting in main field and management	18.00	35.00	32.53
Management of adult palms	32.50	40.83	35.33
Integrated disease management of coconut	70.00	66.79	50.75
Integrated pest management of coconut	41.50	36.80	17.50
Mean	**37.68**	**42.73**	**34.30**

Clustering coconut farmers – A successful extension approach for enhancing adoption and income from marginal and small holdings of root (wilt) disease affected areas

Coconut is being cultivated in small and marginal landholdings. The farmers require capacity building for making right choices of technologies to be adopted, efficient use of internal inputs, improving unit area productivity and income, overcoming the constraints of fragmented land holdings, involving whole family for coconut based integrated farming with special emphasis to women and youth and income generation through value addition enterprises.

The extension approach of 'Clustering coconut farmers' was evolved for integrating these factors. The coconut cluster approach required the following activities.

- Selection of the cluster area – According to the operational convenience-50-125 farm families.
- Cluster initiation and management- Relevant stakeholders (include women, youth, people's representatives, extension officials, research institutes, NGOs of the area, and farmer leaders etc)- maintaining transparency-analyzing problems and constraints.
- Social mapping - map the area with roads, canals, cropping situations, position of households, social units for health, education, religious institutions, markets and other landmarks (Fig. 4).
- Documentation of farm profile - (socio-economic variables, knowledge, adoption, etc.) and palm profile (age, incidence of pests/ diseases, yield etc.) through structured schedule and Participatory Rural Appraisal (PRA).
- Bridging knowledge or skill gaps.
- Encouraging use of internal inputs or human resources.
- Procurement of common inputs in group basis, to reduce time and costs. Farmers cluster conveners, youth farmers clubs and women groups were formulated for implementing common interventions.
- Documentation of all activities and results by the farmers and the field team.
- Promotion of self-perpetuating practices - low cost green manuring eg., Cowpea in coconut basins, low cost vermicompost

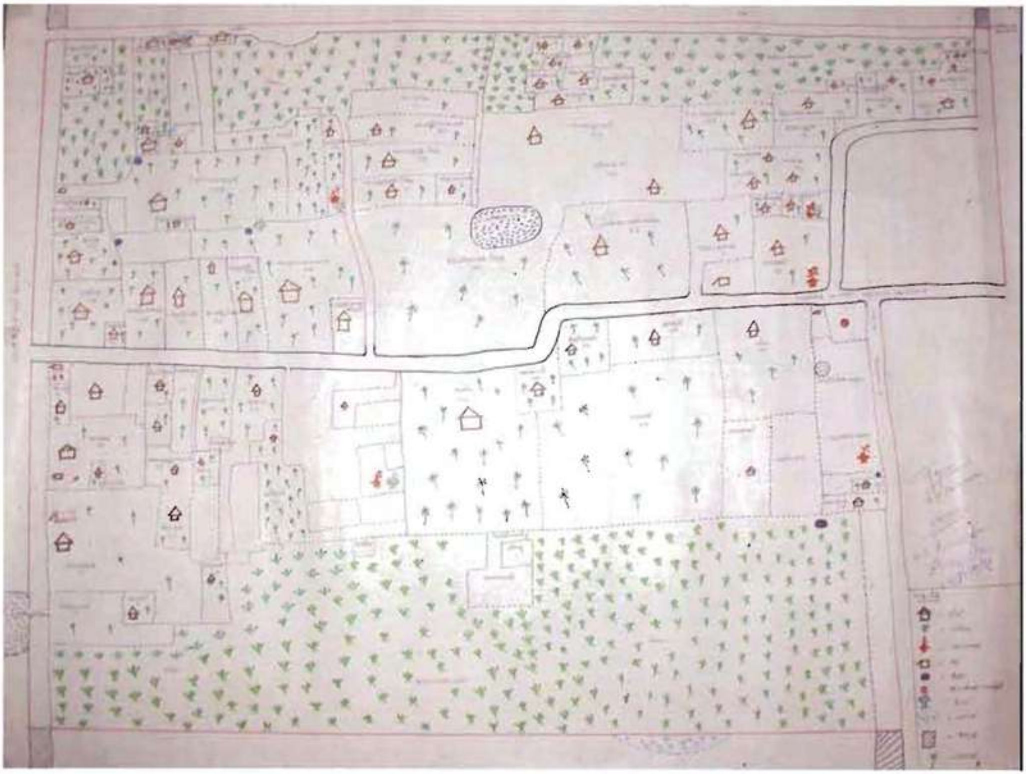


Figure 4. Social mapping of the project area (Nambaruvikala, Karunagappally Taluk, Kollam district)

techniques, backyard poultry, azolla or mushroom cultivation, intensification of inter/mixed cropping through participation/ cost sharing, coconut product diversification or value addition through women self help groups and thus improving income/ employment generation also.

- Post training support in terms of technical services for micro enterprises.
- Facilitating linkages with other agencies.

Impact of coconut farmers cluster approach

The utility and feasibility of cluster extension approach is that, homogeneous households usually do not exist. Hence differences in the socio economic situations of households make technologies unfit on individual household needs or it is unlikely to be adopted. The resources, potential, felt needs, field problems; interest and constraints will be varying from locations and farmers.

Table 7. Impact of the cluster approach in yield of palms and income improvement (nuts/palm/year)

Yield particulars	Recommended management	Low management	Average management	F ratio
Nuts below fist size nuts	26.42	8.55	20.04	27.38**
Nuts above fist size nuts	36.76	17.01	24.89	24.17**
Mean yield	49.97	21.28	34.91	

** Significant at 1% level

Table 8. Impact of integrated management in pest/disease of coconut in root (wilt) disease affected farmers' gardens

Problems	Recommended integrated root (wilt) disease management (%)		Control			
			Low Management (%)		Good Management (%)	
Root (wilt)	Apparently Healthy(AH)	10	AH	2	AH	3
	Disease Early (DE)	35	DE	40	DE	55
	Disease Middle (DM)	24	DM	37	DM	33
	Disease Advanced (DA)	19	DA	21	DA	9
Leaf rot (spindle)	6		24		18	
Rhinoceros beetle	5		28		17	

The yield of palms was calculated as per the formula (Jacob Mathew *et al.*, 2006), wherein the nuts below and above fist size are taken for yield estimation. The plots which received only intercultural operations and occasional nutrition was categorized as low management and average management plots received intercultural operations and farm yard manure application for the palms.

Significant difference in average yield of root (wilt) disease affected palms is depicted in Table 7. as per the level of management adopted. The comparative analysis shows the impact from adoption of recommended package of practices in improving the productivity of root (wilt) disease affected palms. The mean yield of coconut palms improved by 100 per cent, indicating the potential effectiveness of integrated root (wilt) disease management practices in improving health and yield of palms. Between the management levels 25 to 44 per cent reduction in yield could be noted in low and average management plots.

The data given in Table 8. indicates the need and impact of integrated root (wilt) disease management practices recommended by ICAR-CPCRI in improving the health of disease affected palms and management of leaf rot disease , the major factors in reducing health and yield of root (wilt) affected palms. Hence, it could be deduced that the level of management practices adopted by farming community is a major factor in improving the health and productivity of coconut in root (wilt) disease affected areas.

The data depicted in Table 9. shows the role of integrated management of root (wilt) disease in the overall health management of the crop, leading to doubling of productivity of palms. The reduction in the incidence of pests and the leaf rot disease also indicative of the role of nutrient management in crop health. The significant reduction of leaf rot disease and rhinoceros beetle also help in improving health and vigor of palms. The data on eriophyid mite very clearly shows the role of scientific management in reducing the pest level since farming community of the project area did not adopt spraying options against mite attack.

Table 9. Impact of integrated root (wilt) disease management in crop health and yield

Items	Before Interventions (%)		After Interventions (%)	
Root (wilt) disease	Apparently healthy	12	Apparently healthy	10
	Disease early	32	Disease early	34
	Disease middle	34	Disease middle	36
	Disease advanced	22	Disease advanced	20
Leaf rot	13.10		1.30	
Rhinoceros beetle	56.20		5.10	
Eriophyid mite	M0- Nil	50.50	M0- Nil	75
	M1- Low	16.82	M1- Low	17
	M2 – Medium	24.24	M2 – Medium	8
	M3- high	8.21	M3- high	0
Average yield(nuts/ palm/year)	24		50	

Table 10. Income improvement in coconut based homesteads of root (wilt) affected area

Sl. No.	Land holding size	Average income from coconut (₹/annum)			Average income from intercrops/poultry/livestock in coconut holdings (₹/annum)		
		Before (₹)	After (₹)	Improvement (%)	Before (₹)	After (₹)	Improvement (%)
1	Up to 0.1 ha	687.00	1117.00	71.30	728.00	1737.00	138.60
2	0.11 to 0.2 ha	3272.00	4998.00	52.75	4319.00	6584.00	51.74
3	Above 0.20 ha	9043.00	14317.00	58.00	10519.00	22247.00	112.00

The impact of technological and extension interventions resulted in 71.3 per cent improvement in income from coconut and 138.60 per cent from farming system component, indicating efficient use of resources including family labour in plots up to 0.1 ha in size. In the clusters, farmers also improved their income through collective activities like intercropping banana realizing net income of ₹ 1, 45,000 from 3000 banana planted. Value addition activities of coconut by women group could realize ₹ 9.40 per nut. The group efforts included common procurement of fertilizers/planting materials, pooling of vermicompost produced for farm enterprises, sharing labour of farmers and sharing income with group consensus for further investment in group enterprises. The intercropping intensity of coconut plots enhanced to 4-5 folds area, and farm enterprise diversification improved to 70 per cent from 12.5 per cent.

An analysis of the farmer to farmer technology/information dissemination showed that 20.57 per cent disseminated to relatives, 23.33 per cent to friends, 34.30 per cent to other farmers and 8.80 per cent were not interested in the dissemination activities. The self perpetuating effect of the extension approach was evident from this data with improved purposeful interaction among, within and to other farmers.

The cluster approach model has been scaled up by various agencies like Department of Agriculture, Coconut Development Board and local self governments/panchayaths among lakhs of farmers' gardens through linkage and convergence.

Area Wide Community Extension Approaches (AWCA) in Biomanagement of Rhinoceros Beetle of coconut

Rhinoceros beetle (*Oryctes rhinoceros* Linn.) popularly known as the black beetle is the major pest of coconut in all coconut growing states. This pest affects seedlings, juveniles and adult bearing palms. Severe infestation of young plants leads to reduction in growth, and even loss of such plants in the field. It can also induce considerable yield reduction by the damage inflicted in unopened bunches in bearing palms. The typical symptoms are the geometrical 'V' shaped cuttings in opened coconut fronds. In some cases toppling of spindle leaves also can be noticed. Data indicated very low level of awareness and adoption regarding the bio control agents against the black beetle.

Rhinoceros beetle incidence was reported in farmers field conditions to the tune of 25 to 48 per cent in coconut seedlings and 23 per cent each in pre bearing and bearing palms. The area wide participatory extension programme was pilot tested in Edava grama panchayath in Thiruvananthapuram district of Kerala state involving 5465 coconut farmers in an area of 520 ha having 110143 numbers of palms. This panchayath was chosen for implementation of a pilot project on rejuvenation of coconut gardens by removing disease affected and senile palms and planting new seedlings and thus the efforts on group approaches could synergize while evolving the proposed extension model.

Initiating community based approach

The IPM practices recommended by ICAR - CPCRI consist of mechanical, chemical, cultural and biological methods. A participatory analysis indicated that they prefer low cost, safer, environment friendly and bio control practices to manage the pest.

I stage – Implementing participatory programme involving rural women farmers- introducing them to the technologies on IPM of rhinoceros beetle by field based off campus programmes–Convincing them the visibility of technology impact.

II stage – Farm level *Metarhizium anisopliae* production – involving rural educated women – refining low cost multiplication procedure of ICAR - CPCRI through participatory analysis.

III stage – Production /multiplication of GMF under the facilitation and supervision of ICAR - CPCRI scientists –community based adoption of the technology – panchayath basis.

Bio control methods are preferred by farming community as environment friendly, safe, cost effective and efficient as well. ICAR - CPCRI, Regional Station, Kayamkulam has evolved effective bio control techniques for management of rhinoceros beetle, using Green Muscardine Fungus (GMF), *Metarhizium anisopliae*. Rhinoceros beetle lays eggs in cow dung pits, vermicompost units, coir pith, degraded coconut logs etc. Treatment of such breeding sites with GMF effectively brings down the population of the pest. The fungus will not affect the earthworms in vermicompost in any way. Different stages of grubs will be infested by the fungus within a week of its application and adults after a little longer time.

The non availability of sufficient quantities of GMF coupled with low level of awareness of the technology among the farming community were the major obstacles in the adoption of the environment friendly and effective biomanagement technologies. ICAR-CPCRI intervened and facilitated Area Wide Community Adoption (AWCA) strategies in augmenting the technology utilization by refining the technology delivery mechanisms.

As per the ICAR - CPCRI technology, the fungus could be multiplied at farm level by simple and cheap methodology in rice grains, tapioca chips and coconut water. The *Metarhizium* fungus production was decentralized through farm level GMF multiplication units operationalized by trained farm women groups. The capacity building and skill up gradation of the units were done by the ICAR – CPCRI scientists, as a continuous process of confidence building. Another strategy was effective building up of network and linkage with relevant stakeholders like Department of Agriculture, coconut farmers' groups, Veterinary Department, Milk co-operative societies, farmers, mass media especially All India Radio, local self governments etc., for rapid spread of technology and multiple level of interventions. This model project was implemented in Edava grama panchayath, Thiruvananthapuram district during 2010-13 which proved to be very effective in field situations and enabled rapid spread and utilization of technology in other areas.

Approximately 2000 hectares of area in three panchayaths were brought under the process in Thekkekara, Devikulangara and Edava panchayaths of Alappuzha and Trivandrum districts. Two to three women groups of 12-15 members in each ward were involved in technology transfer activities and treatment of breeding sites. Thus a total of 150-200 women were mobilized to represent the panchayaths in popularizing and adopting the technologies. This indicated that these technologies were very much women friendly, simple and adoptable.

The initial cost of setting up of the unit costs only ₹ 8000 – 10000/-.The basic items required were a pressure cooker (20 litres capacity), culture of Green Muscardine Fungus (GMF), Polypropylene covers, quality rice and other accessories like cotton, aluminum foil, thick candles, hand gloves etc. Ensuring hygienic conditions is the foremost requirement in farm level production (FLP) of the fungus. The application method is very simple, one packet of GMF is to be mixed with one litre of water and sprinkled over the cow dung pits, compost pits, decayed coconut logs etc. which are the breeding sites of rhinoceros beetles. The grubs could be found dead by 5-7 days.

While planning for area - wide community adoption programmes, initially all the potential breeding sites of rhinoceros beetles in each ward of the panchayath may be mapped and treated with GMF as a one week campaign with the active involvement of various stake holders. It requires only ₹ 20, 000 – 25,000/- per panchayath for this progarmme. The impact analysis of this programme at Edava indicated 70 per cent to 80 per cent reachability to the potential adopters and 75 per cent reduction in fresh incidence of rhinoceros beetle, especially in the bearing palms, thus reducing the yield loss to farmers. Participation and functional linkages at grass root level could influence the technology utilization in a positive and effective manner.

Components of area wide community extension approach

The reachability and efficiency of the extension set up (Krishibhavans at Panchayath level with one agricultural officer and 2-3 assistant agricultural officers) among the farming community will be very less to expectations, due to multifunctional responsibilities other than technology dissemination/ facilitation activities. The initial efforts on extension approaches for improving adoption of GMF among coconut farmers initiated in 2007 in two panchayaths of Alappuzha district, but resulted in poor field responses and failure of FLP units. Hence in 2008 initiated FLP unit with a qualified person, but it did not sustain and an area wide campaign for treatment of breeding sites of the pest 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 in more than 5000 ha, subsequently.

Identifying critical/ potential adopters

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 and adoption and improved 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 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, render the community level adoption of the technology by other coconut farmers ineffective. Another lesson learned was technology 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 (7 nos), coir processing sites with 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 six 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 two months and post intervention data indicated 75.8 per cent 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 and infected beetles using pheromone traps indicative of reduction of pest population.

Extension interventions

The extension interventions included simple extension literature in local language, field visits and fortnightly small group meetings, off campus

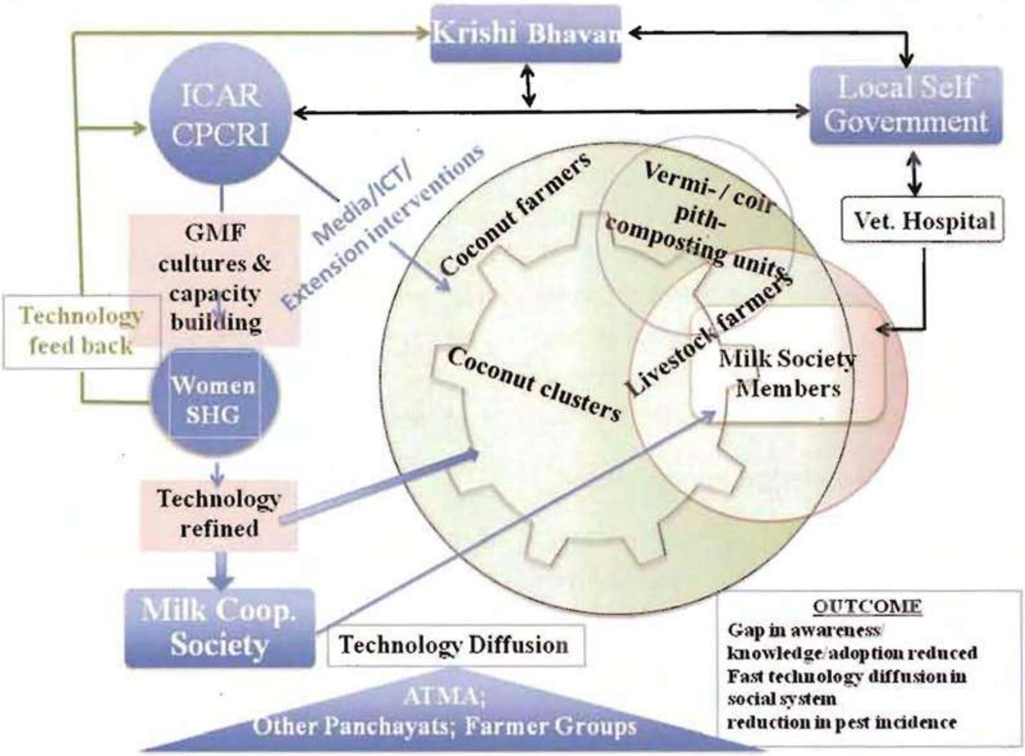


Figure 5. Community extension approach of biomanagement of rhinoceros beetle

training programmes (32 nos) for farmers and farm women, video conference with experts for midway corrections and feedback (7 nos) and low cost farm level GMF multiplication unit by the women group for decentralized sustainable bio input availability. The continuous supply of GMF was ensured through supply of mother culture from ICAR-CPCRI for every batch and total of 6000 packets were distributed in the project area and other districts on demand. The quality of the multiplied fungus was ensured by testing colony formation units (cfu) of samples from sample lot provided to ICAR - CPCRI laboratory. 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.

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, which was approved by the experts on further examination. Thus AWCA proved to be not a passive process but involved interactions among and between stakeholders improving technology demand and utilization.

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, Thiruvananthapuram district) compared to non-intervention area (control farmers) (Neendakara grama panchayath, Kollam district). More than 90 per cent farmers of both areas could identify adult beetles and 50-60 per cent knew common breeding sites and symptoms of infestation. Around 50 per cent of sample farmers knew that mortality of coconut seedlings may occur due to rhinoceros beetle infestation. The data also indicated that planned efforts are needed in awareness creation on time of highest rhinoceros beetle infestation(less than 5 per cent) and potential yield loss due to the pest attack, so that farmers could put the research into

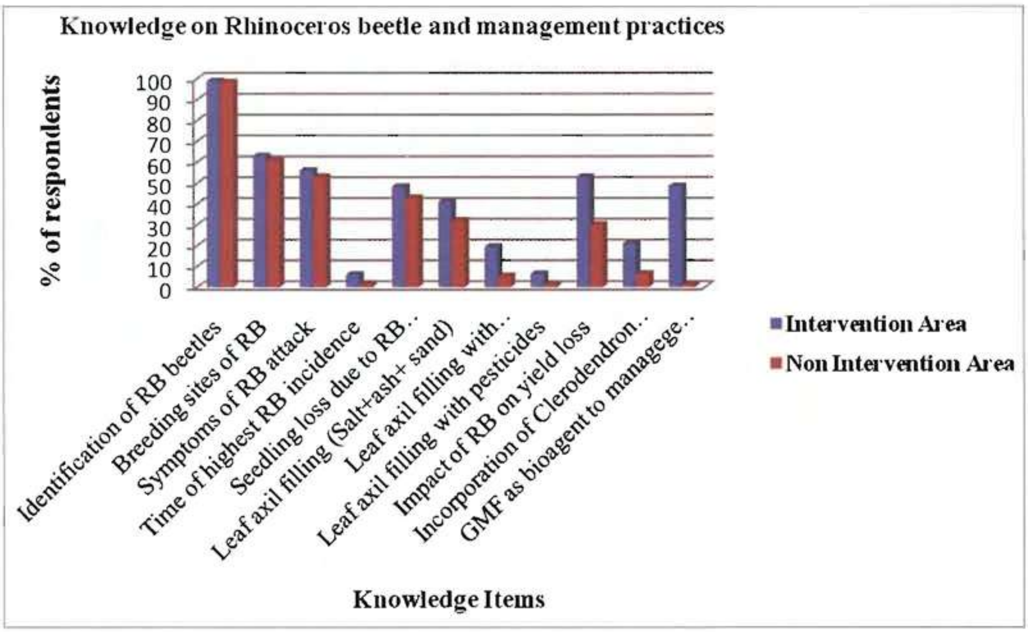


Figure 6. Knowledge of Rhinoceros beetle infestation and management practices among respondents (%) (n=100)

use effectively. The difference in knowledge on GMF treatment of breeding sites and *Clerodendron infortunatum* incorporation warrants community based educational programmes/ interventions in bio management of rhinoceros beetle of coconut.

Data in Figure 6. indicates reduction in knowledge gap by 10-40 per cent among coconut farmers of Area Wide Community Approach area (Intervention area) compared to non-intervention area.

Relationship of socio-economic extension variables with knowledge of coconut farmers

The correlation of socio personal and economic variables indicated that land holding size, number of bearing and non bearing palms in the farmers plot, intensity of intercropping in coconut gardens, trainings attended, extension contact, extension participation and mass media exposure were positively and significantly correlated with the knowledge of coconut farmers regarding AWCA of bio management of rhinoceros beetle. (Table 11.)

The non significant relationship showed that technology specific community extension interventions exert positive effect on the improvement of the knowledge of farming community overcoming the age differences in knowledge acquirement. The involvement and extent of farming systems practiced by the farmers may improve demand for technical knowledge for better output. This factor was reflected in the relationship found with number of bearing and non bearing palms and intensity of intercropping practiced in coconut gardens. Even though livestock farmers are the potential adopters of the bio control practices the community should know the associated bio management practices like leaf axil filling, mechanical destruction and prophylactic measures in positive impact creation, which was reflected in the relationship with extension contact and participation and mass media exposure. In area wide approaches mass media exposure plays larger role in creating awareness and dissemination of message to mass audiences.

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 the 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.

Table 11. Relationship of socio-economic variables with knowledge of coconut farmers - intervention area (n=50)

Sl.No	Variables	'r'-value
1	Age	0.119
2	Education	0.075
3	Farming experience	0.059
4	Land holding size	0.235*
5	Number of non-bearing palms	0.293***
6	Number of bearing palm	0.256*
7	Intensity of intercropping	0.477***
8	Live stock possession	0.106
9	Inputs used in coconut	0.199
10	Trainings attended	0.300**
11	Social participation	0.208
12	Extension contact	0.285**
13	Extension participation	0.365***
14	Mass media exposure	0.311***

*Significant 5 % level ** Significant 1 % level *** Significant 0.1 % level

Table 12. Impact of the community extension components

Sl. No	Variables	Before interventions	After interventions	$X^{2\#}$
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

* Significant at 5 % level

It was established that education and training programmes led to positive perceptions of the advantages of biomanagement technologies among coconut farmers.

The area wide extension approach could improve the role and involvement of women farmers directly and indirectly in facilitating technology adoption in coconut. They could have meaningful partnership in technology dissemination, facilitating technology adoption, technology refinement and access to technologies developed by ICAR-CPCRI along with wider linkages and participation.

The awareness on AWCA among extension officials of the State recorded significant improvement before and after the social and

Improvement in technology access and facilitating role of women in coconut cultivation

Particulars	Role in technology dissemination	Output
Master trainers	Farmer to farmer technology dissemination	Trained 2300 farmers of various districts
FLP of GMF – Technology facilitation through supply of inputs	Master trainers in FLP. Critical input providers at decentralized level	983 women farmers – 5 districts. Produced and distributed 6000 packets of GMF
Technology refinement	Women group – reduced drudgery, time & cost	Cost reduction - 40 per cent Time reduction - 30 per cent
Technology access to women	Trainings- baculovirus, GMF, Coconut value addition, scientific practices	19 trainings, 720 women participants
Women participation in technology implementation	Participatory survey of RPW, technology adoption	520 ha, 17 wards
Linkages of women farmers with agencies	NGOs, women SHGs, LSGs, Dept. of agriculture/ industries/rural development, CPS, KAU, ICAR -CPCRI,ICAR - CTCRI,ICAR - CIFT, KVKs, Farmer innovators, progressive farmers	

technical interventions. This factor will lead to scaling up of the technology and social process in other areas. Feedback and responses from extension officials indicated positive impact of spread to other farming communities also. Establishment of knowledge intensive area wide community based approaches to pest management and the utilization of integrated biomanagement technologies lead to acceptable solution to problem of pesticide misuse. But it requires continued efforts and components for sustainability and acceptability among coconut farmers' communities. Hence research inputs for converting the farm level production units to village level enterprises with attractive product and shelf life, technical supervision and facilitation for quality control needed. Otherwise the success and sustainability of the units will get limited and short term. The study also recommends appropriate extension process for technology and problem specific situations for better technology utilization and research into use.

The project interventions included community level awareness and actions, convergence of group efforts, linkage with extension agencies, decentralized production of bio agents, participatory monitoring and federating women farmers groups for improved technology access. The focus on specific adopter categories and community extension approach in wider area could overcome the inefficiency of individual level technology adoption and wide variation of farmers' socio-economic resource base. This proved to reduce the cost and time of technology diffusion and utilization in communities. The study also put the focus to the need for technology / crop/community based appropriate extension approaches /strategies for better technology utilization.

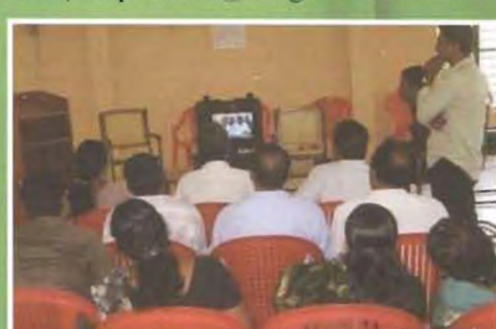
Appropriateness of the extension strategies or approaches in disseminating technologies adoptable by the farming community attains importance in view of the diversified resource levels and farming objectives. The socioeconomic and personal factors affect the effectiveness and scale of technology adoption in any social system. Hence it was learned from this experiences that technology/ farming system specific extension approaches could increase the adoption of technologies, offer scope for area wide appraisal and evaluation of effectiveness, feedback on refinement of technologies, and faster technology dissemination. The approaches put forth paradigm shift from individual level to community level empowered with community participation.

Capacity building of rural women –Farm level *Metarhizium* production

Breeding site inspection for grub population

GMF infected rhinoceros beetle

Master trainers (farm level GMF production) imparted trainings in 6 districts



Training through video conference to farmers of Kasaragod district

भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch