Community Extension Approach in Bio-management of Rhinoceros Beetle, the Major Pest of Coconut

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ABSTRACT

This paper describes the community extension approach evolved for bio management of rhinoceros beetle, the major pest of coconut. The diffusion and adoption of the bio control technologies were below 5 per cent in a study conducted in 2012. Hence alternate extension approach evolved as participatory action research programme during 2010 – 2013. The approach identified the potential adopters or critical adopters as focal points in achieving area wide technology efficiency. The critical adopters were the livestock farmers, vermiculture units, coir processing centers and locations with decayed coconut logs and they were mapped for implementing the strategies. The variables age, education status, farm experience were not significantly correlated with knowledge of farmers showing positive effect of the approach in overcoming individual barriers. Farm size, number of bearing and non-bearing palms, intensity of intercropping, trainings attended, social participation, extension contact, extension participation and mass media exposure were significantly correlated with farmers' knowledge. Project interventions included community level awareness & 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 impact on improvement in knowledge, research/extension linkage, extension contact, extension participation, trainings attended was statistically significant after the extension interventions. The study also put forward the need for technology / crop/ community based appropriate extension approaches for better technology utilization.

Key words: *Critical adopters; Impact; Farmer groups; Participatory action research; Coconut;*

Coconut (*Cocos nucifera*) is major crop of India providing livelihood to more than 10 million farm families, who are mostly resource poor. Coconut is cultivated in 93 countries in an area of 12.61 million hectares and the production during 2013 is 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 belonging to the state Kerala *(Mathew, 2011)*

Infestation of pests and diseases is the most cited production constraint of the crop. 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 palms. It was reported that the pest could cause 10 per cent yield loss in bearing palms.

The Integrated Pest Management 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 less than 5 per cent of the coconut holdings (*Anithakumari et al., 2012*). They 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.). The susceptibility of rhinoceros beetle to this fungus and its mass multiplication for field applications was standardized by ICAR-CPCRI. But as stated earlier, even after three decades, the diffusion rate of this invention was very low. It thus makes sense to conclude that the conventional extension approach failed to disseminate this technology among coconut farmers. Alternative approaches are therefore to be evolved for effective utilization of this research finding for the benefit of coconut farmers. Following a participatory action research programme involving over 5000 coconut farmers from a contiguous area of 520 ha, the objectives were to evolve community extension model for enhancing dissemination and adoption of bio-management of rhinoceros beetle of coconut and impact analysis of the extension approach, which is described in this paper.

METHODOLOGY

The participatory study was conducted during 2010-2013, at Edava grama panchayat in Thiruvananthapuram district of Kerala state. It involved 5465 coconut farmers in an area of 520 ha. Coconut is the predominant crop cultivated in all 17 wards of the panchayat. 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.

The community extension approach evolved puts the potential adopters or critical adopters i.e., the livestock farmers or those with breeding sites of the pest at the central point for adoption of bio control technology in this context. Effective linkages and network building with relevant stake holders (Department of Agriculture, coconut farmers' groups, Veterinary Department, Milk co-operative societies, farmers, mass media especially All India Radio, local panchayath etc.) were developed for rapid spread of technology and multiple level of interventions.

As per the refined technology of CPCRI, the fungus could be easily multiplied at farm level by trained farm women groups for enabling decentralized access. By ensuring hygienic conditions and training support a unit can function in an ordinary room with initial cost comes Rs. 8, 000 to Rs. 10,000. The basic items required are pressure cooker (20 l capacity), culture of GMF, polypropylene covers, quality rice and other accessories like cotton, aluminum foil, thick candles, hand gloves etc. Nuclear culture of the green muscardine fungus (GMF) *Metarhizium anisopliae* (Metsch.) Sorokin for the farm level production (FLP) by women group was provided from Entomology laboratory of Central Plantation Crops Research Institute, Regional Station, Kayamkulam. The basic methodology utilized for farm level multiplication of GMF was developed by *Coconut Research Institute, Sri Lanka (2007)*. This was further modified by *Mohan et al. (2010).*

For application, one packet of GMF (100g) is mixed with one litre of water and sprinkled over the breeding sites. The beetle grubs could be found dead in a week's time. Such treatment of breeding sites is to be done only once in a year.

The Rhinoceros Beetle damage was quantified before and after interventions by recording number of geometric 'V' cuts in fronds, from 2500 palms sampled in the area. Participatory survey conducted involving coconut farmers' groups and women farmers self help groups facilitated by experts using simple score cards. Knowledge of farmers assessed using knowledge test giving score of 1 for correct and 0 for wrong answers in intervention and non intervention areas. Age and farming experience were measured in terms of completed years, land holding size in hectare, intensity of intercropping based on number of crops and area cultivated. The impact on extension variables were collected using standard techniques and compared between intervention and non intervention areas. Awareness among extension officials of the State was documented based on telephone interview. The data from farmers were collected through personal interview method. The collected data were processed using descriptive statistics, Pearson correlation analysis and Mc Nemar test of significance

RESULTS AND DISCUSSION

Perennial crops cultivated in contiguous manner in small and marginal holdings poses extension challenges, for pests and disease management, in risk prone areas (i.e., root (wilt) disease affected). *Anithakumari and Mohan (2010)* reported that rhinoceros beetle attack were 48.31 per cent in coconut seedlings and 22.7 per cent each in pre bearing and bearing palms. Around one third of the total fronds were found to be affected by the pest attack. Palm survey in NATP project area of Alleppey district showed that 45 per cent of the palms were having rhinoceros beetle infestation. (*NATP Final report*, *2003*). Hence this pest attains importance in the performance of the crop and livelihood of coconut communities. For this study the Area Wide Community Approach is operationally defined as community based IPM effort in an area of not less than 500 ha of coconut in a continuous geographical area, with stakeholder involvement.

Components of area wide community extension approach : The reachability and efficiency of the extension set up (Krishibhavans at Panchayat level with one agricultural officer and 2-3 agricultural assistants) in reaching out 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 started in 2007 in two panchayats of Alappuzha district with poor field responses. 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.

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

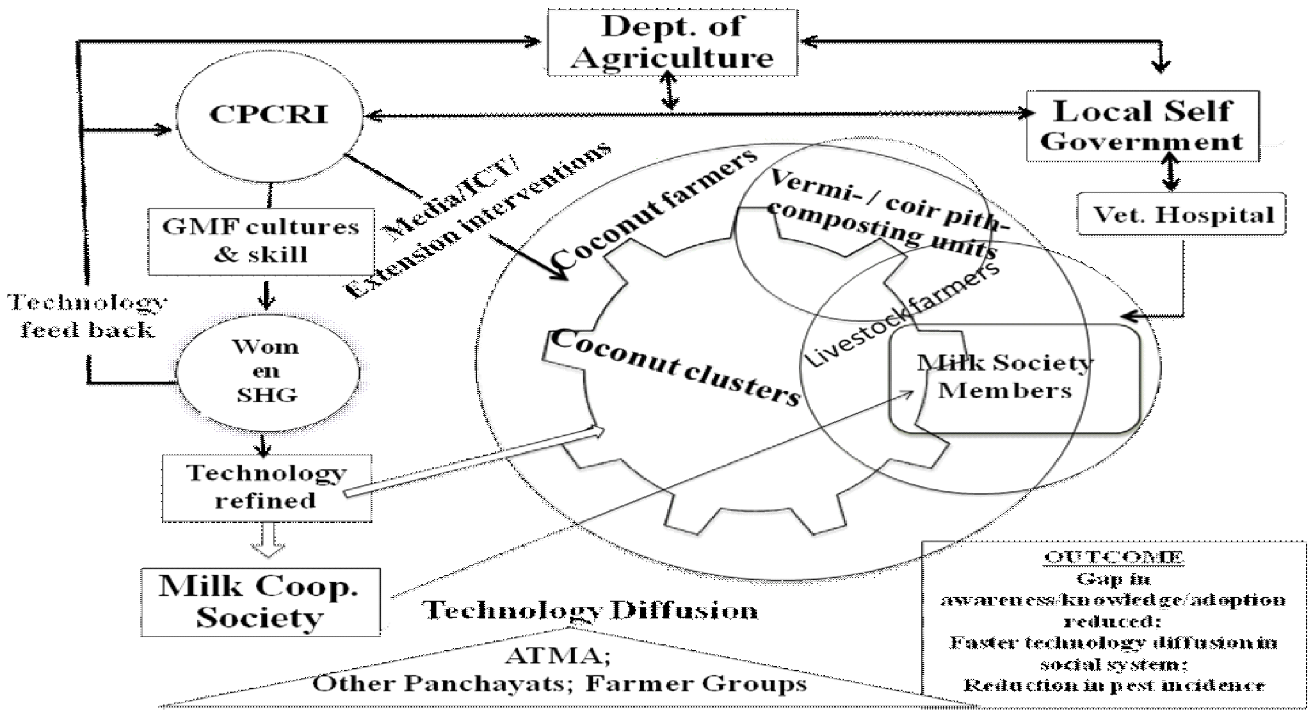

Fig.1- Community Extension Approach (AWCA) of Bio-management of Rhinoceros beetle

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 ineffective. Another lesson learned was technology integration of indigenous technical knowledge (ITK) like incorporating Clerodendron plants in breeding sites and leaf axil filling with salt/sand/ash mixture with recommended technologies.

The scattered breeding sites of rhinoceros beetle in the panchayath ie., livestock farmers (643 nos), vermicompost units (7nos), coir processing sites with coir pith heaps (3 nos) were mapped 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 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 ward, indicative of reduction of pest population.

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

Table 1. Knowledge of Rhinoceros beetle and management practices among respondents (N=100)

Knowledge Items	Study Area (%)	Non-study Area (%)
Identification of adult rhinoceros beetles	98.00	98.00
Breeding sites of Rhinoceros Beetle	64.00	60.00
Symptoms of Rhinoceros Beetle infestation	56.00	52.00
Time of the highest infestation of Rhinoceros Beetle	8.00	2.00
Seedlings lost due to Rhinoceros Beetle attack	59.00	52.00
Leaf axil filling with Salt+ash+sand	50.00	42.00
Leaf axil filling with Naphthalene balls	18.00	7.00
Rhinoceros Beetle infestation reduced coconut yield	51.00	30.00
Leaf axil filling with chemical pesticides	6.00	2.00
Clerodendron incorporation in breeding sites	20.00	3.00
GMF against Rhinoceros Beetle	38.00	1.00

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 cost 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 which was approved by the experts on further examination. Thus AWCA proved to be dynamic, involving 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 effective 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) (Neendakara grama panchayath, Kollam district) as per Table 1 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 the highest rhinoceros beetle infestation(less than 5%) and potential yield loss due to the pest attack, so that farmers could put the research into 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 Table 1 indicated reduction in knowledge gap by 10-40 per cent among coconut farmers of Area Wide Community Approach compared to non-intervention area. This is in tune with results reported by R*ao and Sridhar (2014)* comparing demonstration and control farmers.

Relationship of socio-economic extension variables with knowledge of coconut farmers: The correlation of socio personal and economic variables given in Table.2. 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.

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.

Table 2. Relationship of socio-economic extension variables with knowledge of coconut farmers - intervention area (N=50)

Variables	'r'-value
Age of respondent	0.119
Education level	0.075
Farming experience	0.059
Land holding size	0.235*
Number of non-bearing palms	0.293***
Number of bearing palm	0.256*
Intensity of intercropping	0.477***
Live stock possession	0.106
Inputs used in coconut	0.199
Trainings attended	0.300**
Social participation	0.208
Extension contact	0.285**
Extension participation	0.365***
Mass media exposure	0.311***

*Significance @ 5%, ** 1%level,*** 0.1%level

The impact of AWCA recorded in Table 3 showed 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. Jayawardana and *Sherif (2010)* also found that education, self confidence, innovativeness, information seeking behavior correlated positively with adoption of organic farming practices in coconut based homesteads.

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

Table 3. Impact of the Community Extension components

Variables	Before interventions	After interventions	$\chi^{2\#}$
Social participation	1.18	1.89	0.164
Extension contact	1.62	8.13	4.35*
Extension participation	0.20	4.37	4.51*
Mass media exposure	3.22	3.55	0.042
Trainings attended	0.08	0.23	3.99*
Research linkage	4.026	19.75	4.53*
Extension linkage	17.80	28.04	3.88*

#Mc Nemars test of significance value
*Significance at 5% level
^Average scores of each variable given

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.

Martey et al., (2014) opined agricultural development programmes should target farmer based organizations as well as support them with technical trainings to enhance their technology uptake, in agreement with findings of this study. 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.

CONCLUSION

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.

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