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DEFYING ADOPTER CATEGORIES AMONG FARMERS: LESSONS FOR EXTENSION

Technology adoption in agriculture may not always follow the classical adopter categories wise progression as indicated in the Diffusion of Innovation theory proposed by Everett M Rogers. Based on a long-term action research study on bio management of Coconut Rhinoceros Beetle (CRB), in this blog, Anithakumari P illustrates the need for a more nuanced approach to look at technology dissemination and adoption.

CONTEXT

Extension services, in general, follow an individual farmer centric approach in promoting new technologies in agriculture. Such an approach is less effective especially while working with small and marginal farmers. In the case of coconut, small and marginal farmers dominate the sector and they are engaged mostly in homestead farming. The ICAR Central Plantation Crops Research Institute (CPCRI), Regional Station, Kayamkulam (Kerala) pilot-tested several technologies among coconut-based homestead farmers, especially in root (wilt) disease affected areas. The disease is of a debilitating nature, adversely affecting the health and productivity of affected palms and there are no absolute control measures. Root (wilt) affected coconut palms are more vulnerable to pests and diseases, adding to the income and investment woes of homestead farmers.

CRB infested coconut palms-"V" shaped cuts indicating infestation

The CPCRI experiences indicated the inefficiency of individual farmer-based technology dissemination and adoption in managing the major pest, Coconut Rhinoceros Beetle (CRB). Non-availability of bio control agents and non-consideration of area wide distribution of breeding sites (which many times fall outside the coconut holdings) in technology dissemination were the main reasons for the lack of success. The imperative of reaching out to a large number of farmers (7 to 12 farmers per hectare) added to the problem. Varied adoption and non-adoption of technologies by individual farmers reduced the efficiency of CRB management in general. Hence, adoption of an area-wide community extension approach – coordinated by groups – was promoted to bring down individual garden-based variability in order to significantly reduce pest incidence throughout the area of intervention.

AREA-WIDE COMMUNITY EXTENSION APPROACH (AWCA)

Field research conducted by the CPCRI among coconut farmers indicated that farmers prefer low cost, safer, easily adoptable control practices to manage the pest, since palms are grown mostly in house plots. Bio management is preferred by the farming community as they are environment-friendly, safe, cost-effective and efficient as well. A report indicated that IPM components were partially adopted by 36 per cent of coconut farmers, whereas knowledge and adoption of bio management stood at only 2.1 per cent (Anithakumari et al. 2012). The dismal level of knowledge and adoption of bio management of coconut pest triggered refinement of the prevailing extension strategies in the farmers' system, and the process is depicted in Figure 1.

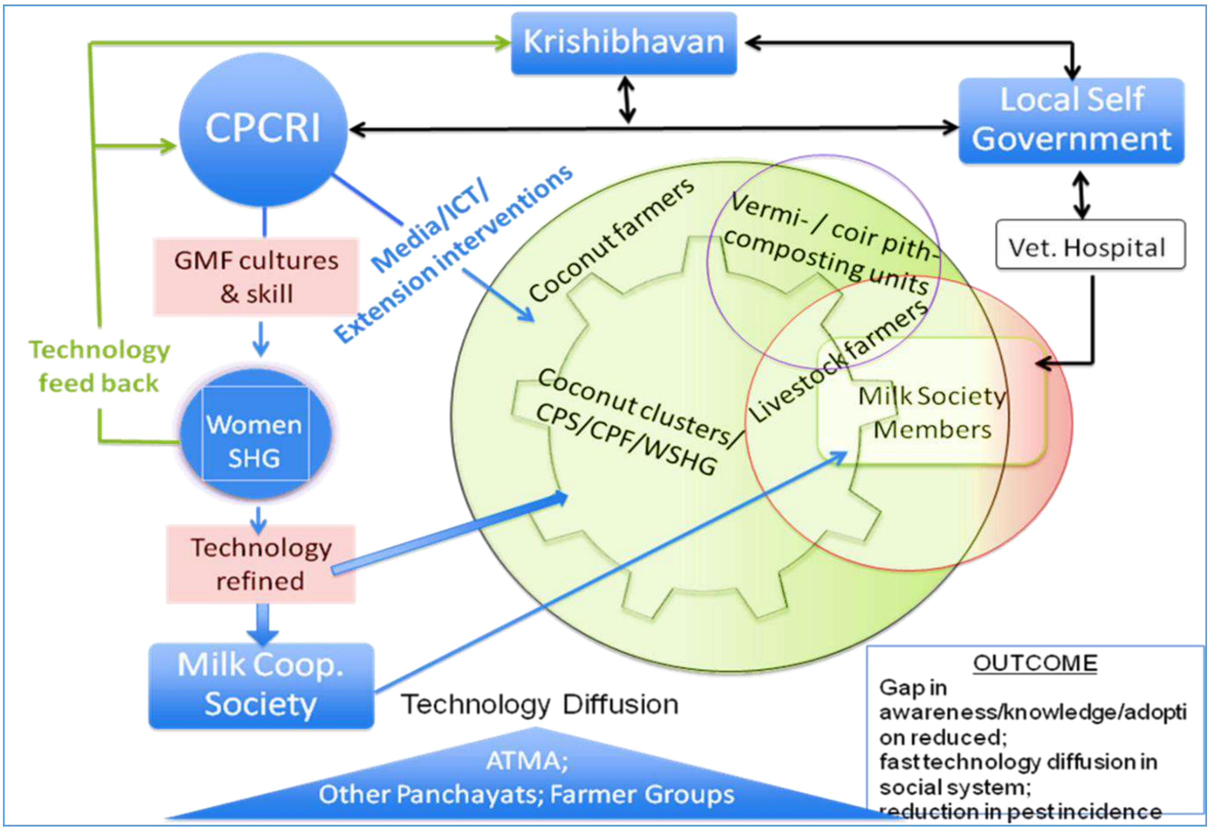

Fig.1 Area wide Community Extension Approach (AWCA) of Bio-management of Rhinoceros beetle

2007-2009 period: Pilot-level field research was initiated in two panchayats, Thekkekara and Devikulangara, of Alappuzha district during 2007, covering 1500 ha of coconut cultivation. ICAR-CPCRI, evolved effective bio management techniques against CRB as a component of the Integrated Pest Management (IPM) using *Metarhizium anisopliae*, green muscardine fungus (GMF). The major constraints identified were non-availability of critical inputs (bio agents) and non-awareness. In discussion and linkage with the extension agencies, farmers and experts of ICAR-CPCRI implemented extension interventions, such as on- and off-campus training programs, method demonstrations on application of bio agents, five result demonstrations in each panchayat, extension literature in local language and agri clinics/advisory services on a ward basis. Mass media campaigns were also organized as per a pre-arranged schedule. With regard to providing high quality bio agent (GMF) the entomologists suggested replicating the Farm Level Production (FLP) of green muscardine fungus (GMF) based on the simple method followed in Sri Lanka. A rural youth qualified in micro biology was selected and trained on laboratory and unit initiated production. Sadly, the attempt was a total failure with a high level of contamination in spite of expert support, and the low cost method was rejected as non-viable. Furthermore, reaching out to a community of more than 5000-7000 homesteads (marginal farmers) without appropriate social process was seen as a huge task to undertake given the existing TOT system.

The lukewarm response of the farming community called for a rethinking of the entire technology, knowledge and adoption status, segmentation of adopters, as well as extension-based answers and solutions necessary to overcome this state of affairs. We learned that social participation and group dynamic skills are vital for overcoming the problems of small and marginal sized coconut holdings and also to realize faster and purposeful reach out.

2010 to 2013 period: Based on the lessons gained, the process was further taken forward for another field-based action program in Edava panchayat – in an area of 520 ha of coconut cultivation in 5465 homesteads with 110143 palms in a contiguous manner. This panchayat was selected for our field research, as the Coconut Development Board's flagship programme on rejuvenation of coconut gardens (cut and removing old and low yielding palms, replanting seedlings and their management) was first implemented in this location. This program could trigger an incidence of CRB due to area wide cutting and problems of piling of organic debris stimulating breeding of the pest, according to experts. Hence as extension experts, we conducted participatory combing survey on the pest incidence, palm age wise severity of pest attack, breeding sites of the CRB in the area, knowledge and adoption levels, input availability and social institutions. Participatory Rural Appraisal (PRA) was the most helpful in eliciting information from different social strata.

Interactive Sessions with Extension Functionaries and Farmers

Farm-level GMF production (FLP) units were initiated by women farmers' self help groups for decentralized production and supply of bio agents. The requirements were two 20 litre capacity pressure cookers for sterilization, cotton for plugging PPE covers, polished rice grains, four numbers of big sized candles, GMF culture (from CPCRI) and trained participants. Quality control of the product was ensured by the ICAR-CPCRI laboratory for each batch. The FLP technology was adapted and refined by the group, based on their needs and resources, resulting in a saving of 30 per cent of the preparation time (cooking of uniform-sized rice grains reduced to three minutes instead of 15 minutes as instructed, thereby reducing contamination and ensuring optimum fungal growth) and 40 per cent of cost (avoided use of cotton balls and PVC pipe pieces for plugging which was replaced with multiple folding of mouth portion and stapling tightly with equal results), which clearly indicated the role of women in technology facilitation and refinement, when associated. Repeated discussions and visits with KVK experts, pathologists and mutual learning of women group members were the inputs for continuous improvement. They produced 6000 to 8000 packets annually for supply to other areas also.

The area-wide community adoption strategy was thus evolved; it involved the CPCRI as technology provider and also as a major actor involved in capacity development of social units through convergence and linkage. One panchayat (500-1500 ha) was found to be practical as adoption unit for the AWCA, and also suitable for congenial support mechanisms of local institutions and social mobilization. The major partners and participants in this scheme included the Department of Farmers Welfare and Agriculture Development (Krishibhavan)/Agricultural Technology Management Agency (ATMA) for networking and linkage with Local Self Government for up scaling, coconut farmers' groups (coconut producers clusters/society), Department of Animal Husbandry/milk co-operative societies and mass media (print and All India Radio). While planning for panchayat wise community adoption programs, initially all the potential breeding sites of CRB in the panchayat were mapped with GPS and treated with GMF as a one-week campaign with the active involvement of various stakeholders. The total cost was only INR 25,000 per panchayat for this programme. The participatory interventions also resulted in significant improvement in training participation (43%), social and extension participation (58%), extension contact (66%) and mass media exposure (51%) of the farmers when compared to the pre-intervention period.

Box.1. Coconut Rhinoceros Beetle (CRB)

Oryctes rhinoceros (L.), the coconut rhinoceros beetle, is a ubiquitous pest species occurring throughout many tropical regions of the world. Adults can cause extensive damage to economically important wild and plantation palms. The pest infests seedlings, pre-bearing and bearing coconut palms, causing crop loss or yield reduction. The pest is reported from Africa, Asia, Middle East, North America, Oceania, etc. Generally integrated pest management (IPM) approach is recommended, which consists of multiple control options to keep pest populations below economic threshold level. One of the major bio control agent of this pest is the green entomopathogenic fungus, *Metarhizium anisopliae* (Sundara Babu et al. 1983). In breeding sites, the fungus may be applied for larval control and is distributed by adults. This fungus acts as a biopesticide on immature stages of the beetle (Bedford 2014). Zelanzy (1979a) reported an average of 4 to 13% nut yield reduction due to frond damage by CRB. CRB infestation was reported to be 48.31 per cent in coconut seedlings and 22.7 per cent each in pre-bearing and bearing palms in Kerala State (Anithakumari et. al. 2015).

The fungal bio agent (*Metarhizium anisoplaea*) is recommended for application in CRB breeding sites for destruction of larvae as adult beetles may spread it. The general breeding sites are FYM/ cowdung pits in homesteads, coir pith heaps in coir making units, dead and decayed palm trunks in homesteads due to red palm weevil or diseases.

HOW DOES THE ADOPTION PROCESS OF FUNGAL BIO AGENT FOR CRB MANAGEMENT DIFFER IN HOMESTEAD SOCIAL SYSTEMS?

To fully appreciate the adoption process of fungal bio agent in this case, one needs to understand the nature of homestead social systems. Coconut homesteads are varied and are of average holding size of 0.22 ha with random integration of different farm components. They act as farm level ecological units for household needs, providing market surplus also. CRB management was introduced in these homesteads of less than 1 hectare, held by farmers with varying attitudes, motivation and resources.

Extension system needs dynamic strategies in dealing with technology dissemination in such systems. These strategies should combine area and community-based approaches with participation of varied stakeholders in technology selection and adaptation. The roles of actors in the AWCA process of CRB management evolved over time through participatory interventions. Even though the roles were played with responsibility and sincerity, we learned that the leadership from each actor contributed to the sustainability and up scaling of these strategies in other districts as well. The roles and major actors are given in Figures 2 and 2.a.

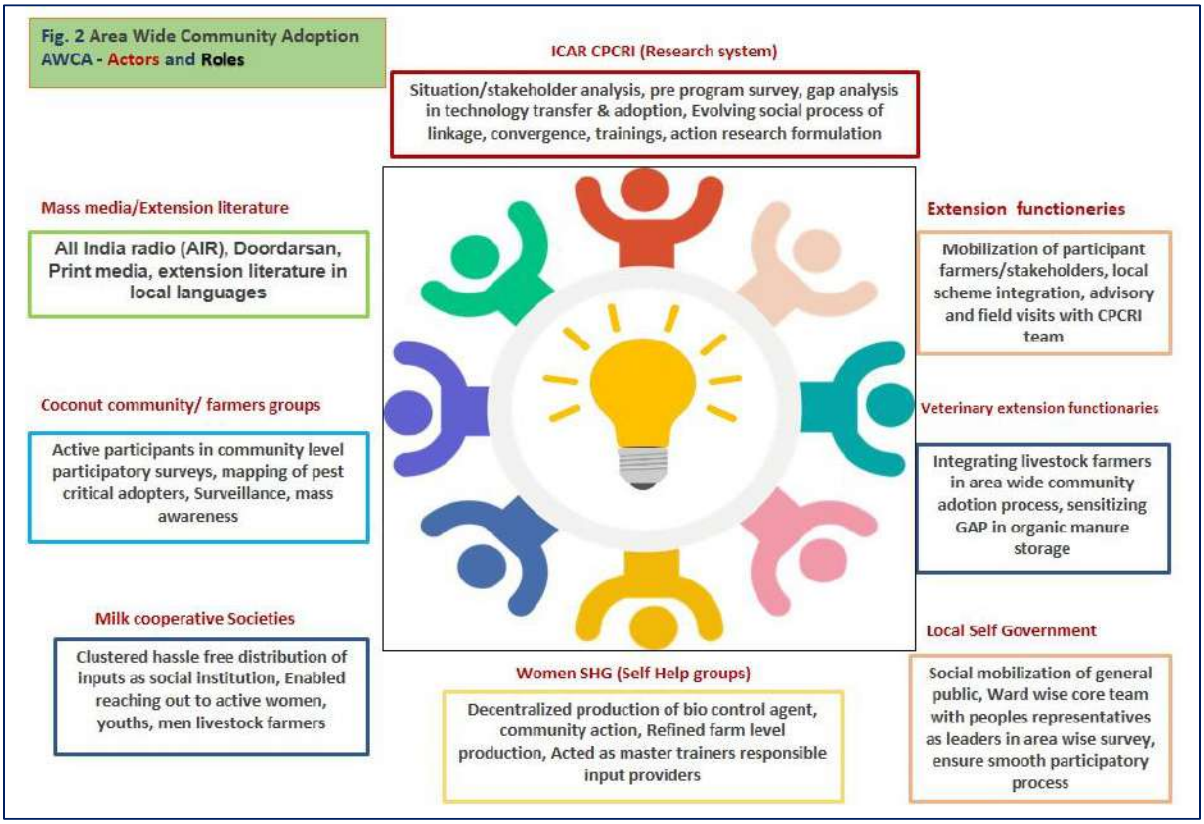

Fig. 2 Area Wide Community Adoption AWCA - Actors and Roles

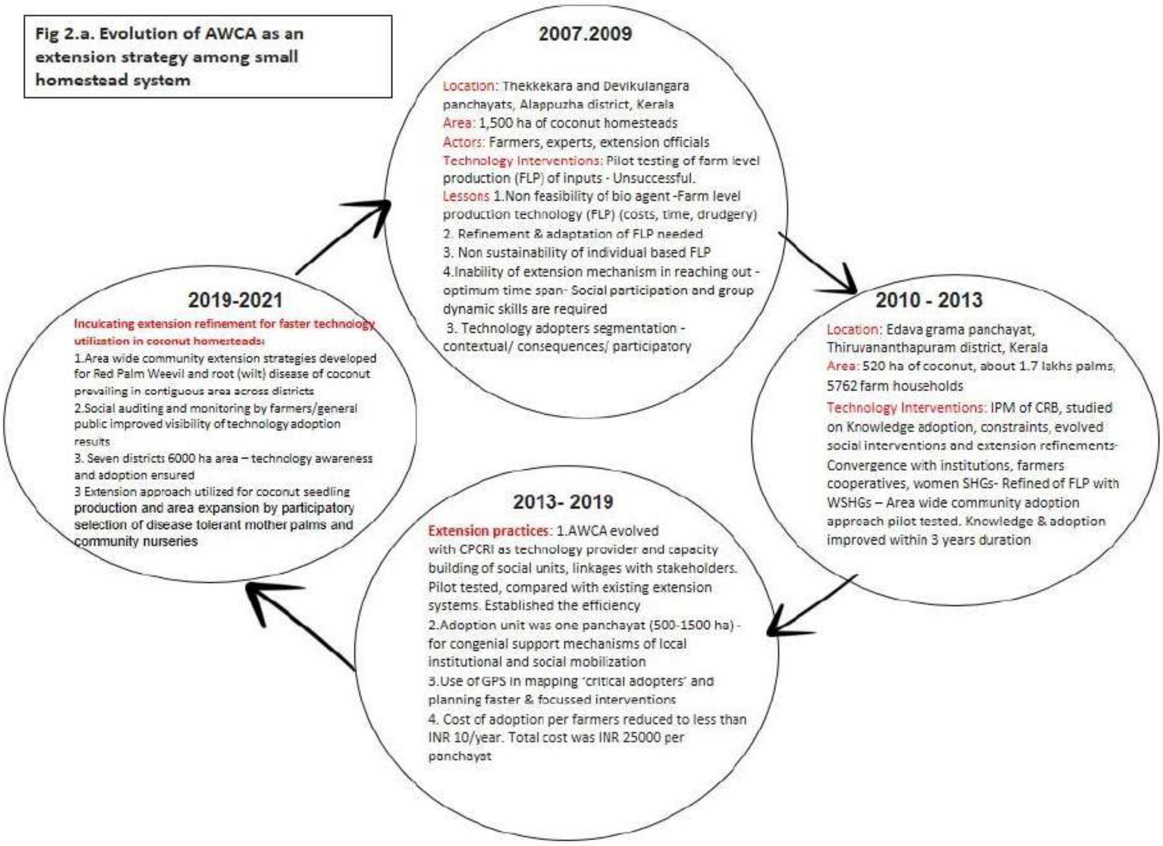

Fig 2.a. Evolution of AWCA as an extension strategy among small homestead system

LESSONS

Pilot testing of AWCA for CRB management revealed several important lessons, which are summarized below.

Role of critical adopters

Critical adopters are farmers crucial for enhanced positive consequences of technology adoption in the allocated farming society, without whom as adopters, the technology impact cannot be achieved. As in the case here, they are inadvertently contributing to a general problem affecting the entire community of palms. The critical adopters could fall under the general adopter categories as well, but technology adoption may not always directly benefit them, but could be beneficial to a larger section of farmers. The critical adopters in this case, namely the livestock farmers, coir units and compost producers having foci of pest multiplication, may not necessarily be coconut farmers *per se*, thus defying the general adopter categories (Box 2). GIS, for area wide decision making in extension interventions with precision, is a tool of efficiency.

Box.2. Mapping of Critical Adopters

The scattered breeding sites of rhinoceros beetle in the panchayat – livestock farmers (643 numbers), vermicompost units (7 numbers), coir processing sites with coir pith heaps (3 numbers) – were mapped, indicative of the locations in each ward. It was found that 82 per cent of these potential/critical adopters were distributed in six wards, where more concerted efforts were implemented. The other wards needed simple and low scale extension interventions only saving time, cost and manpower. They were reached through coordinated efforts of people's representatives, extension units of the 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 critical 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/adult beetles (using pheromone traps) could be collected from all wards, indicative of a reduction in the pest population.

Identification and mapping of critical adopters enabled the extension system to bring visibility to the hidden connections of technology adoption and public consequences among homestead systems in marginal land holdings. This also led to development of appropriate extension strategies, more precise reach out and more efficient use of inputs. In area wide approach of CRB, extension methods, tools, interventions, extent of linkages and convergences with relevant stakeholders could be decided based on mapping of critical adopters and severity levels of the pest incidence. The cost of extension reduced in terms of labour charges through linkages and convergences. Time taken for spread of technology across the system was only eight years (2007-2013) of AWCA. This is important given that this technology was developed five to six decades earlier – indicating much delay in technology dissemination and utilization. The existing wide gaps in continuous and improved technology supply in the coconut innovation sector calls for further analysis.

Field challenges and compatible extension

Analysis of the field situation indicated that the critical adopters may not be distributed evenly in all the wards of a panchayat (Wards are the lowest administration unit of local self-government in Kerala State with a people's representative). Hence mapping of wards in a panchayat enables identification of the stakeholders to be linked or converged for technology dissemination and adoption. This warranted individual extension approaches in wards with sparsely scattered critical adopters, and participatory group interventions in other locations.

Close surveillance on CRB Investigation at the field level

Why technology adaptation and refinement matters

Small and marginal farmers form complex systems of linkages, networking, resource base, knowledge acquisition pattern, perceptions, attitudes and associations within and among them. Hence extension mechanisms need customized refinement as per technology characteristics, physiology of the crop and farming systems. In homestead systems we can observe the apparent uniformity among farmers with regard to technology needs or knowledge/adoption potential. An area wide community approach in extension could play an effective role in situations that overlook the segmentation of adopter categories.

Responsible technology dissemination

The points of community learning vis-à-vis reducing complexity of technology use, ease of demonstration and trial, observability of results, and compatibility with Indigenous Technical Knowledge (ITK) occurred due to planned social actions. The ITK of incorporating *Clerodendron infortunatum* (a local weed plant) was found to make the fungal treatment of CRB breeding sites more effective as well as acceptable at large. The FLP of fungal culture by women SHGs was a standout intervention exhibiting ownership of the technology by the actors. Regarding detection in natural situations, scientists had no clue initially and the critical adopters also responded that after Metarhizium treatment they could not recover dead larvae from breeding (treatment) sites. Eventually farmers observed the presence of ant lines in the treated cow dung/compost/coir pith sites, leading to the affected grubs. This confirmed the effect of Metarhizium on CRB larvae, making them lethargic initially, then fading of larval colour, and finally death within a week. AWCA built technology awareness, dissemination, triangulation and evaluation within the farming community with minimum external bias. This has resulted in more ownership and better confidence in the potential of the technology. Trust and proximity among actors, commitment, sharing and cooperation are outcomes observed in AWCA and determines the success of community extension.

Quality feedback of tacit knowledge for refining research outputs and outcomes

Perennial presence of host plants (coconuts) provides a congenial ecosystem for thriving of the ubiquitous pest (CRB). The AWCA led to refinement of CPCRI's recommendation that CRB breeding sites be treated once in 2-3 years since it was observed that fungal spores are active for that duration in laboratory conditions. In actual field situations the farmers used FYM/cow dung during April-May for planting tubers and other inter crops in coconut groves. The usual recommendation was to retain a portion of the Metarhizium treated organics in the pits/tanks so that it will multiply eventually in the added up organic manures. But farmers noted that this was not happening and larvae were observed in such sites, questioning the effectiveness of the technology. This feedback was verified and found to be genuine in field sites. The research showed that high temperature and low humidity during March-April months hinders Metarhizium multiplication, unlike in the laboratory. Hence the recommendation changed to yearly treatment of CRB breeding sites instead of once in three years.

Socially coordinated farm-to-farm IPM on area basis reduced cost of extension

The onus rests on 'critical adopters' as contributors to the problem, which means, for coconut farmers as the responsible technology adopters, even though most of them are not direct beneficiaries of the technology. Furthermore, it strengthened utility of technology adoption in reducing variability on the efficacy of the technologies across the system of intervention as compared to the household or individual level technology adoption among coconut communities. When compared to individual level adoption, farmers were of the opinion that there was 70-80% reduction in cost in area wide technology adoption. The FLP of bio control agent itself reduced input cost by 30 per cent and mobility for access too. Reaching out to critical adopters rather than individual coconut households reduced time, efforts and expenditure for extension functionaries. The reduction of pest infestation was in adult bearing palms, thereby reducing major cost of climbing charges (60 per cent of plant protection operations) for palm crown treatment as recommended. The use of chemical insecticides and engaging climbers individually, deterred small farmers from adopting regular plant protection for coconuts in homesteads. Thus AWCA induced economies of scale.

IMPACT

Shift of adoption unit to contiguous geographical area

The overall percentage of infestation in the pre-project period was 72.9±9.3 and it significantly decreased to 58.1±9.1 in the post-project period, in the intervention panchayat. The area-wide impact of the community adoption approach was very clear as compared to the control panchayat of Kollam district, where general extension advisory services were in operation instead of AWCA. The pest incidence did not decline, but rather, it was the same during 2010 and 2013 (74.5 and 74.6%, respectively). The impact of AWCA was more or less geographically contiguous (Fig 3). AWCA, with critical adopters recommended for technology dissemination and adoption mode by ICAR-CPCRI, was implemented in seven districts in an area of 6000 hectares of coconut, until 2020.

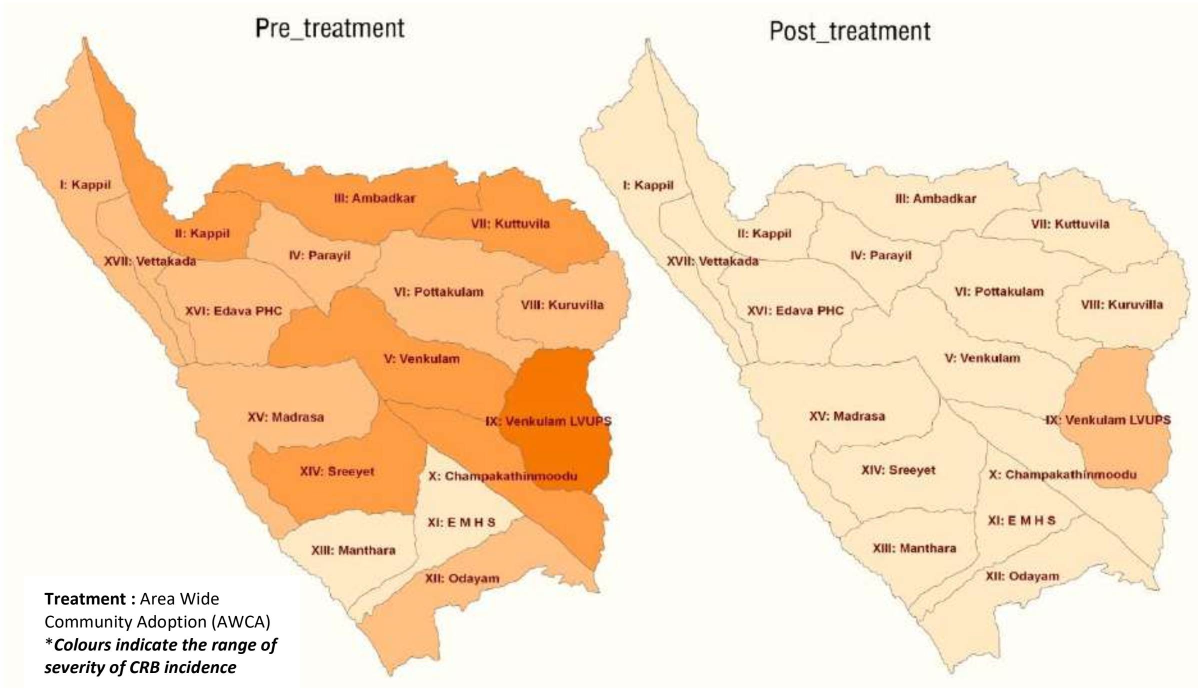

Fig. 3 Area wide result of technology adoption through AWCA– Edava Panchayat, Thiruvananthapuram District, Kerala State

IMPLICATIONS FOR EXTENSION RESEARCH

These experiences reveal the need for re-looking at the adoption process and technology recommendations.

Firstly, there is a need for continuous monitoring of technology performance at the field level under different extension settings (e.g., individual approach vs. area-wide approach). With the introduction of every bit of new knowledge at the field level there will be dynamic changes, and to fully understand the technical and social adaptations that happen, agro-biological scientists and social scientists need to undertake more detailed exploration on the performance of technology, second generation challenges that might emerge, as well as look for new opportunities in enhancing adoption.

Secondly, at the individual level farmers choose to be either an innovator or a laggard based on their decisions with regard to adopting technologies. But several studies challenged the adopter categories in terms of factors affecting the decisions at micro and macro levels. However, Rogers's theory still continues to hold good in explaining and strategically planning acceptance of knowledge, technologies and ideas. Given the Theory of Reasoned Action (TRA) individuals generally do not act independently of influences from their own social or cultural arena. A person's intention in support of a particular behaviour is the major predictor which precedes the actual performance. The behavioural intention occurs as a result of the conviction that the performance will lead to a specific outcome (Blue 1995). They will be continually reporting their behaviour back to important reference groups. In extension research the extent and access of research and extension institutions as the reference groups among farming community needs analysis in the wake of online extension resources, which are readily available in need-based formats.

Thirdly, the consequences of adoption can be private, public, or both, as the case may be. Readiness to adopt technology by forcing an innovation may have to be modernised for jointly evolving and playing critical roles in the use of such innovation. The social impact/public consequences of technology dissemination and adoption – as evident from AWCA – call for impact analysis on a system basis as well. The decisions for adopting technologies follow different pathways in individual and community approaches. The dimensions of access, equity, institutional structures, and common investment by community organizations require further study and analysis.

The consequences of technology use are to be largely viewed and assessed within the paradigmatic dimensions of ecology, energy efficiency, psychological benefits, climate resilience, carbon foot print, and socially responsible consumption behaviour. Extension research and approaches need to be scientifically responsive in knowledge and innovation creation, rather than individual process models.

Public consequences refer to the impact of an innovation on those other than the actor, while private consequences refer to the impact on the actor itself, which was elicited by Barbara Wejnert, in her article, 'Integrating models of diffusion of innovations'. The contextual uniqueness of technologies or methods in agriculture may not be shared in theories and adopter categories, which are focused on individual behaviour and decisions. The interconnections among farmers and stakeholders in the social system, with very small holdings of physical contiguity, strong kinship with influence of leadership are to be considered in community level extension.

These results have implications on the way extension is organized and emphasises the need for stratification of farmers as community/groups/clusters rather than only as adopter categories in the scenario of limited man power and resources. The resources could be more effectively invested in educating and empowering extension functionaries by refining the curriculum and field functioning for higher impact.

CONCLUSION

Technology adoption in agriculture, resulting in public after-effects often defies the general adopter categories among farming communities – as seen in the case of CRB. The bottlenecks of extension projects and programs while covering the majority of small and marginal farmers sustainably requires participatory studies. It also calls for evolving approaches and strategies appropriate to technological, social, biological and geographical contextualization. Sustainable adoption requires subjective evaluation of technology characteristics with which to evolve technology dissemination pathways.

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