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Perceptions of Farming Community in Relation to Problems in Farming and Prospects of Coconut Mite Management in Bangladesh

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Abstract

A study was conducted to analyze community perception on homestead agro-biodiversity and conservation of coconut genetic resources at Bagharpara Upazila (Sub district) of Jashore district, Bangladesh in October 2011. Tools and techniques of Participatory Rural Appraisals (PRA) were utilized to identify the socio-economic factors and agronomic practices influencing homestead agro-biodiversity. The participants identified coconut as a leading species in the homesteads. Communities suspected that the wave (electro-magnetic) generating from mobile phone towers was the cause of damaging coconut in their villages. Being disheartened with continuous yield loss, the farmers have resorted to fell down their coconut trees and shifted to cultivating fruit trees or suitable field crops. The research team used the matrices of PRA to develop a problem tree, which marked mite infestation in coconut as the focal problem. The developed problem-tree was transposed into an objective tree. Based on the objective tree, the research team was able to develop and implement a three-year research project on mite management in coconut involving farmers as implementers. The intervention stimulated community knowledge and skills towards mite management and conservation of unique traditional coconut varieties.

Key words: Agro-biodiversity, coconut, mite, PRA, Problem tree

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Introduction

Coconut is one of the important homestead crops in Bangladesh, and it is grown along with other fruit and vegetable crops. It is one of the most stable perennial crop and considered as a reliable source of income for most of the rural communities. It bears fruits round the year and captures atmospheric carbon for its growth, thus promoting a healthy atmosphere. Recent outbreak of mite (*Aceria guerrerronis* Keifer) has been identified as one of the serious problems of coconut in Bangladesh. Mite resides beneath the bracts of young fruits and suck sap from the fruit and injuring the tender portion. The injury caused by mite ultimately leads to producing wart-like structures (known as "warting") and longitudinal fissures on the fruit surface (Ramarenthinum *et al.*, 2000). Mite infestation prevent the growth of the fruit and the size of the shell and kernel are significantly reduced. Mite damage decreases both quality and quantity of the fruit, causing difficulty in de-husking operation and reduces fibre quality of husk. It is notable that production of coconut in Bangladesh has decreased from 90 thousand metric tons in 2004 to 33 thousand metric tons in 2012 (BBS, 2014). Being despaired due to continuous yield loss, many farmers are now cutting down their coconut trees and utilizing the land by shifting to cultivating other fruits or field crops. In addition, harvesting of tender fruits each year for drinking purpose is negatively influencing seedling production. Thus, coconut in Bangladesh is now under a threat of genetic erosion (Islam *et al.*, 2017). Mite management in coconut is quite difficult because of the tall stature of the palm. In order to control mite infestation, it is necessary to climb up the coconut trees for spraying the coconuts, which is not only tedious but also risky. Birds and wind carry the eggs and adults of mite with field debris where they harbor and thus it spreads from plant to plant quickly. Because of the nature of damage, the approach of mite control in individual palm or in a household plantation is not successful. The control approach should be based on a community level (100 families) or ecosystem level (500 to 1000 hectare). Considering the facts, the study was conducted to build on to and support experienced-based knowledge on coconut with scientific-based experiments involving farmers.

Materials and Methods

The study was conducted in Bagharpara Upazila (Sub-district) in Jashore district in October 2011. Farmers Participatory Rapid Appraisal (FPRA) tools and technique were used to elicit farmers' knowledge on natural resource management techniques involving coconut (Eyzaguirre and Batugal, 1999). Households having less than 0.25 ha land area and fewer number of plant species were discarded. A multidisciplinary PRA expert team, comprising of horticulturist, entomologist, plant pathologist, extension specialist, and agricultural economist, was formed and educated on guiding the participants and data recording procedure of the intervention. The host farmers were informed 3 days earlier about the program and activities to be conducted in their farms. Age groups of the participants ranged from 18-80 years. The team leader briefed the participants on the purpose and procedure of the program. Women were grouped separately, and a lady scientist was in-charge of discussion. Males were divided into two groups and each group had at least two scientists. The exercise focused on the varieties of coconut, problems relating to coconut, income from coconut, plant species and biodiversity in the homesteads and other socio-economic issues. The research team followed up the communities on their discussion and documented their perception and attitudes towards mite attack in coconut. The community listed all the problems relating to coconut production and homestead bio-diversity. Research team and community members constructed a problem tree. The problem tree was converted into objectives and root solution.

Data analysis: The data collected were summarized and the means and percentage of various scoring data were computed for interpretations. The number of plant species and their relative abundance in the homesteads were measured by using Shannon-Weaver Diversity Index (H′) where H′ ranges from 0 to 1; one indicates the maximum diversity (Yu Li *et al*,

1996). H′ defined as: $H' = -\sum P_i \log_2 P_i$,where P_i is the proportion of the total number of genotypes belonging to the i^{th} class. The exact numbers of plant species define the classes. Each H′ value was standardized by dividing it by its maximum value $\log_2$ n where n is the number of species. This gives the Standardized Index (SDIc) = $-\sum P_i \log_2 P_i / \log_2$ n. Relative prevalence (PR) of species by using the formula PR= population of the species/homesteads X % homesteads with the species containing a particular species (Millat-e- Mustafa, 1997).

Results and Discussion

Demographic characters of the participating community

Family size of the participating community consisted of more than six members, one of them being the earning person, although three persons of a family were capable to work. Male-female ratio was 1:1. Ratio of workable male to workable female of the family was 1:2. Seventy percent holdings were medium to large 2-6 ha while 30% was small holdings, (0.25 to 1.0 ha) The community possessed diversified occupation opportunities, including cultivation of own lands and employment as daily labor. Traditionally, women could not go outside of their residence for income generating activities. Men were the main actors of expending from family income. Contribution of women to household planning was negligible. During harvesting, the women supported the men (Table 1). Hansen and Sthapit (2000) stated that 70% households were engaged in different resource management practices in the community. The demographic characteristics also indicate an opportunity of production of more agricultural products by utilizing opportunity of family-labor. Islam *et al.* (2011) reported such an opportunity of utilizing women in processing coconut husks in southern parts of Bangladesh. Persley (1992) also described coconut as a subsistence crop of rural communities where women could be employed in processing food and non-food products within their residence.

Table 1. Demographic characters of the respondents

Family size (No)		: 6.2
Male female ratio		: 1:1
Workable member of the family (No)		: 3
	Male	1
	Female	2
Earning person (No)		: 1
Aging people above 60		: 2
Education (%)		
	Male	: 80
	Female	: 70
Holding size		
Small (0.5-1.0 ha)		: 30
Medium (1.01-2 ha)		: 65
Large (2.0> ha)		: 5%
Occupation		
Major		: Cultivation, business, labor service, service, rickshaw pulling, daily labor
Other		: Petti business, rickshaw pulling, daily labor
Role of women in the family		: Rearing children, cooking foods, helping in agriculture
Role of workable member in the family		Help Farm work, women help in postharvest processing
Labor use		Work in their own field, women help in postharvest processing
Decision making		Men took family decision alone; sometimes discussed with women

Analysis of household income

Household income derived from agriculture was found to decline from 30% in 2000 to 25% in 2012. The sectors of field crops and horticulture were dominant in agriculture. The share of income from non-crop agriculture (animal, forest, fishing and other related activities) has increased and accounted for nearly

Table 2. Partitioning of major income of the household and their trends since 2000

A. Income source	Incidence (%) in each year		Trend	Reason(s) of change
	2000	2012		
Agriculture (Crop and Horticulture)	30	25	Decreasing	Agriculture failed to provide profitable employment of family labors
Service	20	25	Increasing	Inability of agriculture to cope with industrialization trend
Others	50	50	Unchanged	rickshaw pulling, head-loader, transport labor, self-employment
Total	100	100		
B. Composition of agricultural value added				
Crop & Horticulture	70	55		High price of labor, lack of marketing channel
Animal Farming	20	23		Need less labor and marketing facilities
Forest & Related Activities	8	15		Development of local furniture industries and sawmills
Fishing	2	7		Establishment of private hatchery
Total	100	100		

45% of added income from agriculture (Table 2). Women, apart from performing routine household chores, and the activities of preparing food for other members of the family, are also involved in rearing livestock and poultry. Women also participate in harvesting crops. Islam *et al.*, (2017) reported similar decline of income that amounted to 25% to 30% in agricultural sector.

Gender activity related to coconut production

Women took part in postharvest handling and storage of coconut. In case of planting seedling, women influenced men in selecting varieties. Men and children were mostly involved in marketing of coconut and other fruit crops (Table 3). Islam *et al.* (2011) studied socio-economic status of farming communities of Bangladesh based on utilization of coconut and similarly reported a tradition of men-dominated household planning where women had little contribution. However, women in small households actively participated in household income generating activities. In some cases, women were found to override their husbands in taking family decisions considering the future of children.

Plant species and their abundance in the homestead

The community listed 57 plant species in their households, fruit trees being the dominant ones. The estimated diversity index of plant species in the household was 88.0 (Table 4). On the other hand, diversity index within the fruits was 81 although 50% of the individuals belonged to single species. The most prevalent fruits in the homesteads were mango, coconut, guava and date palm. At least 95% of the households had coconut palms (Table 5). The result is an indication that homestead plant diversity possesses a decreasing trend. Uddin *et al.* (2001) also reported highest abundance of coconut palms in the households of southern districts of Bangladesh. FPRA matrix also revealed that there was no exclusive coconut orchard in the community. Coconut is grown with other fruit trees in the homesteads. Higher income might influence planting coconut and mango trees although the community

Table 3. Gender activity related to production of coconut

Activity	Gender (age)	Location	Time	Remarks
Land/pit preparation	Men/children	Farm/Around home	Year round	
Nursery	Women/men/children	Around home	Year round	-
Transplanting	Men/children	Around home	Rainy season	-
Weeding	Men/children	Farm and home	Year round	-
Fertilizing	Men	Farm and home	Before and after rainy season	Generally coconut plant is not fertilized
Harvesting	Mostly Men and children	Farm and home	Before winter (mature nut)	Harvesting of tender nuts round the year
Seed selection	Women/men	Farm/home	Round the year	Nuts which germinated during storage.
Hauling	Men/women/children	Home/farm	Round the year	-
Seed storing and exchange	Women	Home	Round the year	-
Sale	Men/children	Home/Local markets	Round the year	Retailer sometimes visited farmers' house

Table 4. Species richness and diversity index plant group in the homesteads

Plant Species	Species richness	Interspecies diversity (%)
Fruits	22	88.0
Timber	7	
Vegetables	18	
Spices	5	
Cash crops	5	
Total	57	

complained of very low income from coconut at present.

Self-evaluation of household income

There was a time when coconut contributed more than 32% to the total household income. At present, the contribution of coconut to household income dropped to less than 4%. At present, the highest income was recorded in litchi, followed by jujube and date palm juice. About 10 years ago, however, the income from other fruits was insignificant (Table 6). The community reported that mite infestation in coconut (what they termed as mobile virus) was the main cause for significant crop losses and low income from coconut. They wanted to grow coconut if it can regain optimum productivity.

Problems of coconut production

The community identified nine problems associated to low-level production of coconut. However, mite infestation was the dominant one, which made the farmers to shift cultivation to

Table 5. Relative prevalence of fruit species in homesteads

Sl. No.	Fruit tree	Size of species	% household containing the species	Relative prevalence of species	Ranking
1	Coconut	15	95	1425	1
2	Mango	10	100	1000	2
3	Jackfruit	6	60	360	3
4	Litchi	7	30	210	5
5	Jujube	2	30	60	7
6	Betel nut	3	50	150	6
7	Guava	3	90	270	4
8	Hog plum	1	40	40	8
9	Pomelo	1	25	25	11
10	Date palm	19	92	38	9
11	Black berry	2	5	10	14
12	Sapodilla	1	30	30	10
13	Tamarind	1	2	2	18
14	Karambola	1	3	3	17
15	Pomegranate	1	5	5	15
16	River ebony	1	5	5	15
17	Palmira palm	2	2	4	16
18	Wax Jambo	1	15	15	13
19	Rose apple	1	2	2	18
20	Bullock heart	1	20	20	12
21	Indian olive	1	3	3	17
22	Line/Lemon	2	20	40	8
Total plant species=		82			
SWDI (H')=		81%			
Individuals belonging single species		50%			

Table 6. Self-evaluation of household income in the community (2011 and 10 years back)

Fruit tree	Income (Tk/farm)	
	2011	10 years back
Coconut	1500 (3.86)	3000 (32.12)
Mango	7000 (17.95)	1000 (10.71)
Jackfruit	3000 (7.69)	500 (5.35)
Litchi	10000 (25.64)	1000 (10.71)
Jujube	5000 (12.82)	500 (5.35)
Betel nut	1000 (2.56)	200 (2.14)
Guava	3000 (7.69)	500 (5.35)
Hog plum	1000 (2.56)	90 (0.96)
Pomelo	500 (1.28)	50 (0.54)
Date tree	5000 (12.82)	2000 (21.41)
Black berry	1000 (2.56)	300 (3.21)
Sapota	1000 (2.56)	200 (2.14)
Total	3900	9340

Table 7. Farmers' responses on the constraints in coconut production and their scoring

Problem	Insect pest	Vertebrate pest	Mite	Insufficient input availability	Extension service	Adverse climate	Fruit drop	Lack of HYV	Dormancy	Scoring	Ranking
Insect pest	Insect	Insect	Mite	Insect	Insect	Insect	Insect	Insect	Insect	12	3
Vertebrate	Insect	Vertebrate	Mite	input	Extension	Climate	Fruit drop	HYV	Vertebrate	5	5
Mite	Mite	Mite	Mite	Mite	Mite	Mite	Mite	Mite	Mite	17	1
Insufficient input availability	input	Vertebrate	Mite	input	Extension	Climate	Fruit drop	Input	Input	8	6
Insufficient extension service	Insect	Extension	Mite	Input	Extension	Extension	Fruit drop	HYV	Extension	9	5
Adverse climate	Climate	Climate	Mite	Climate	Climate	Climate	Climate	Climate	Climate	13	2
Fruit drop	Fruit	Fruit drop	Mite	Fruit drop	Extension	Climate	Fruit drop	Fruit drop	Fruit drop	11	4
Lack of HYV	Insect	Vertebrate	Mite	Input	Extension	Climate	Fruit drop	HYV	HYV	5	7
Dormancy	Insect	Vertebrate	Mite	Input	Extension	Climate	Fruit drop	HYV	Dormancy	1	8

other crops. Being the new pest in the area, farmers were not familiar with or aware of its management and the associated yield loss (Islam *et al.*, 2008). First time the community came to know about mite attack in coconut from the research team. The research team explained the community how coconut mite (*Eriophyid guerrerronis*) injures tender nut, and damage symptoms appears on nut surface. The community on the other hand explained their experiences of utilization of pesticides, fertilizers, micronutrients, botanicals or spiritual treatments for correcting warting of coconut and which were not related to mite attack. The community identified mite as major problem lead to low income from coconut and they shifted to cultivate other fruits or suitable field crops (Table 7). The research team developed a flow diagram of problems to visualize the inter relationships between different variables of the problem tree. Understanding the dynamics of problems relating to coconut cultivation, the community argued about replanting of senile coconut palms by high yielding hybrids.

Construction of problem tree

As mentioned earlier, the problem analysis process including the identification of focal problem was carried out in a participatory manner. The problem tree technique was applied to analyze the problems of low production of coconut in Bangladesh that implied for planning to develop a program on mite management and revivification of coconut production in Bangladesh. The problem tree is a diagram showing the cause-effect relationship between problem conditions in a defined context. Ammani *et al.*, (2010) explained that the problem tree analysis helps to find solutions by mapping out the anatomy of cause and effect around an issue in a similar way to a Mind map, but with more structure. As the conversation progressed, the discussions, debate and dialogues of the PRA participants were scanned to develop the problem tree. The steps followed to develop the problem tree are as follows:

Step 1: Identifying major existing problems, based upon available information

As identified by the PRA participants, the major problems of low national level production of coconut are: (a) adverse climate, (b) mite attack, (c) less economic opportunities, (d) conversion of coconut area to other fruit trees, (e) insufficient input use and senile state of coconut palms.

Step 2: Selection of one problem for the analysis

From the problems identified the community selected mite attack in coconut palms as the main problem for analysis. This was because of the fact that most of the problems identified could be traced to mite attack in coconut. Thus, mite attack in coconut was taken as the focal problem of coconut cultivation in Bangladesh.

Impact on production and yield of coconut

Mite infestation in coconut in Bangladesh is a recent problem. It is very difficult to control coconut mite because of the tall stature of coconut palms, morphological characteristics of coconut fruit, mode of mite damage and trans-boundary incidence pattern of the pest. Since, mite colonizes in tender nuts, removing and burning of infested young nuts and spraying the fruits with miticide- will stop mite attack in coconut (Islam *et al.*, 2008). As mentioned earlier, mite infestation seriously affects the natural growth of nuts. As a result, the usual size of the nut, shell, and kernel are reduced. The incidence of coconut mite being new in the country, the farmers are neither familiar with it, nor are they aware of control measures and the associated economic losses due to coconut mite. Individual endeavor of mite control is not successful because the nearby-infected palms can easily infest a healthy palm. Ecosystem based community approach is, therefore, sought for controlling mite attack in coconut effectively.

Step 3: Identifying direct causes and effects of the focal problem to construct a problem tree showing relationship to other problems

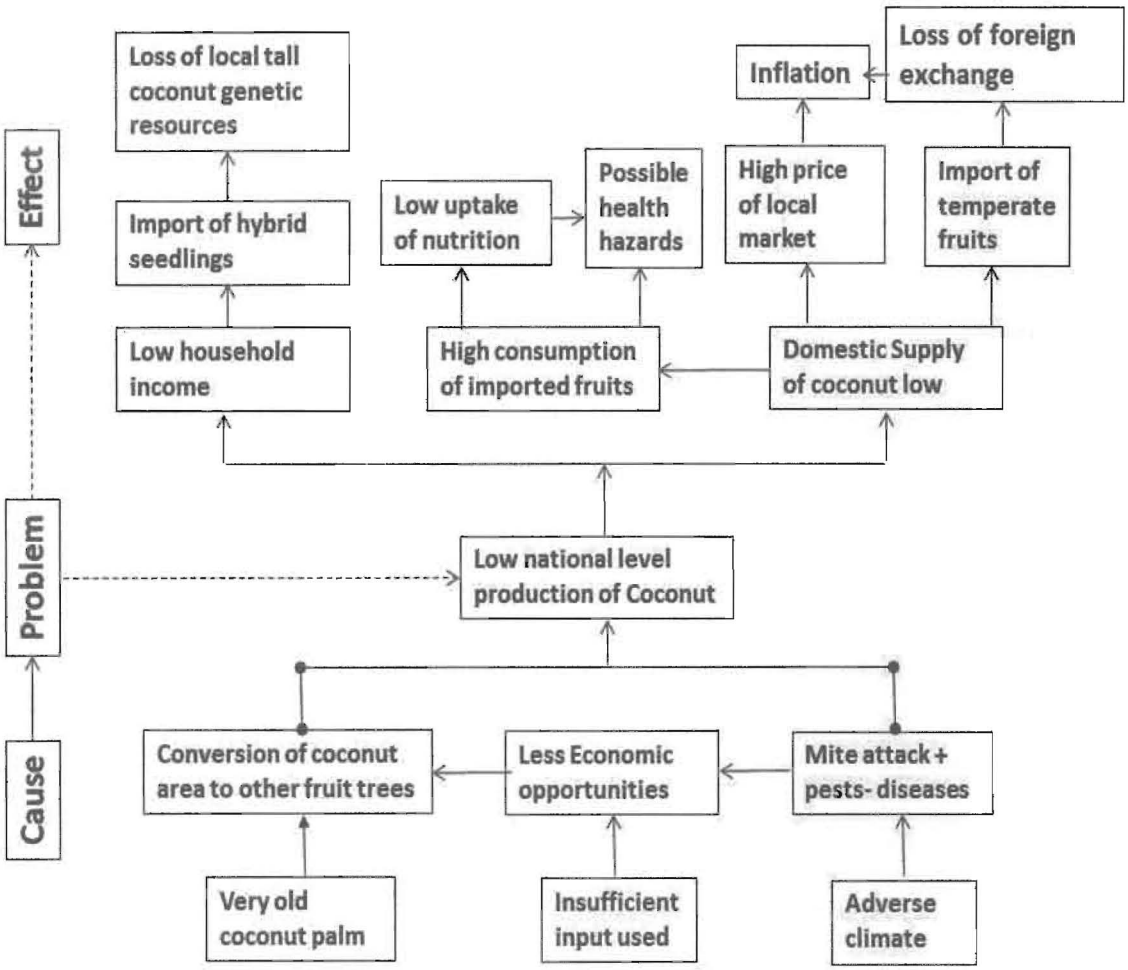

Figure 1. Problem tree

Step 4: Transferring the problem tree into the objectives

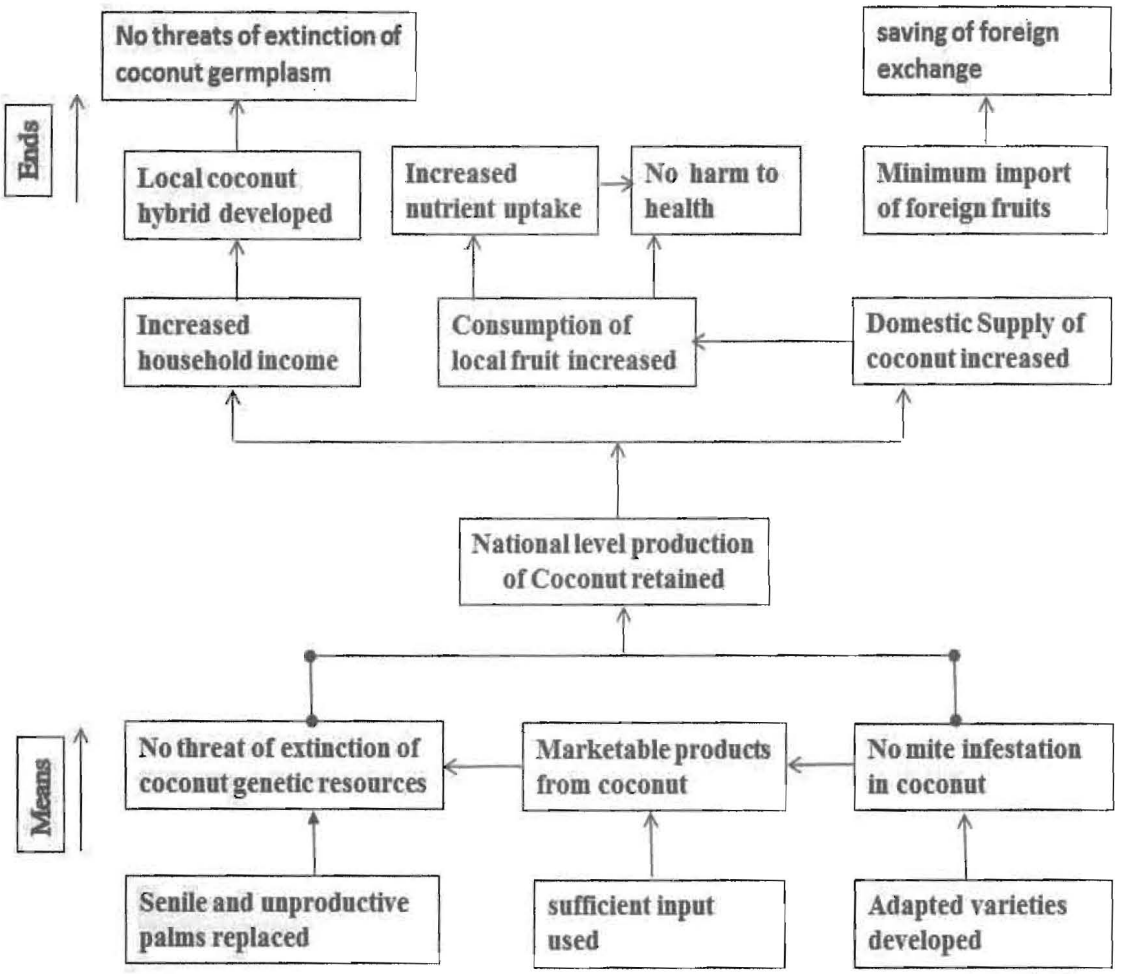

Figure 2. Objective tree obtained by converting problem tree

Step 5: Obtaining root solution to the focal problem from the objective tree

Through the conversion of the Problem tree (Figure 1) to the Objective tree (Figure 2), the root causes of the focal problem were turned into its root solutions. The root solutions for mite management in coconut are:

i) Include farmers in mite management intervention

ii) Enhance technical knowledge and skills of farmers on mite control in coconut

iii) Establish community managed coconut seedling nurseries of high yielding varieties and hybrids

iv) Enhance technical knowledge of farmers on production of coconut scientifically

v) Use of research input to develop local fund for sustaining the process after withdrawing project support

The paper achieved six objectives through analyzing matrices of PRA intervention. From the identified root solutions, the following practical solutions are recommended:

a) Organizing farmers into community based organization (CBO) and strengthen CBO to commit to the process

b) Establishing community based coconut seedling nurseries for replacing senile and unproductive palms by locally selected varieties and improved hybrids

c) Utilize project inputs to generate funds for sustaining the process of replanting and mite management

d) Strengthening research and extension services for conservation potential genetic resources of coconut for future breeding program for developing varieties with desired traits against adverse effect of climate change

e) Production and promotion of marketing of valuable products from coconut

Lesson learnt

Guided by the FPRA results, a three-year project on mite management in coconut was implemented in an area of about 1000 hectare, which included 6 villages and 6000 coconut palms. After the intervention, farmers discovered the following:

- Value addition of unutilized parts of coconut could generate more income and employment opportunities
- Fertilizers, irrigation, fungicides/ insecticides are necessary for higher yield
- Replacement of senile and unproductive palms is necessary
- Blaming mobile phone for cracking coconut was a myth
- Idea of mobile phone tower causing damage to coconut was wrong
- Community understood that cracking of coconut surface is caused by tiny mites
- Mite management requires intervention involving an area of at least 500 hectares

Conclusion

Coconut is a heritage in the community, which they have been practicing from generation to generation. Mite attack disinterested the farmers from cultivation of coconut. Community might become interested to grow coconut if its cultivation were made profitable.

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