Socioeconomic and Livelihood Impact of Invasive Species on Marginal Homesteads: The Case of Aceria guerreronis on Coconut Palms in India

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Socioeconomic and Livelihood Impact of Invasive Species on Marginal Homesteads: The Case of *Aceria guerreronis* on Coconut Palms in India

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Introduction

Alien invasive species are non-native organisms that occur outside their natural adapted habitat and dispersal potential. They are seen as a threat not only to biodiversity and ecosystems, but also to socioeconomic development, livelihood and human well-being. In India, the bioinvasion of coconut palms by an alien invasive mite species *Aceria guerreronis*, popularly known as 'Coconut mite' accounting for enormous economic loss was first noticed just before the start of the new millennium. Among the plantation crops, coconut (*Cocos nucifera* L.) is of prime importance in the marginal homesteads of tropical India. India is the third largest coconut producer with plantation area of 1.9 million hectares and estimated production of 12.8 billion nuts per annum. Coconut sector in India accounts for about 22.36% of the world production while contributes approximately US $1600 million to the total GDP of India, besides providing livelihood securities to more than 10 million people in the country. During the period 2001–02, mite attack has affected nearly 22.36 million coconut palms in 98,400 hectares in prime coconut producing state 'Kerala' in India. The percentage reduction in nut weight due to mite infestation was assessed to be 2.12 %. This paper hence seeks to study socioeconomic and livelihood impact of the coconut mite and also estimates the economic loss in monetary terms from documentary evidence. A gap analysis using sustainable livelihood index (SLI) framework of unpublished primary data collected during the peak year of infestation (yr. 2002) among coconut growing households [N=120] in two villages of Kerala was also carried out to assess the livelihood impact.

Material and Methods

Cross-sectional data collected during yr. 2002 using a questionnaire survey was used for analysing the marginal shock of mite damage on livelihood among two villages in Kerala (South India). The data was analysed using a multivariate probit model to assess the marginal effect of economic shock (dependent variable) and accumulation of capital (discrete variables). The following discrete variables were used (1) Physical assets (denoted by ownership of material assets, such as dwellings, cycle, livestock, tractor); (2) Financial assets (measured by savings balance on accounts); (3) Social assets (membership of one or more networks); (4) Human assets (level of education); (5) Natural assets (ownership of land,); (6) Number of members of household employed in paid work; (7) Gender of person who has control over assets; (8) Locality (defined by panchayat) and data of qualitative nature was obtained . A three point likert type scale was used to convert the qualitative attributes (discrete variables) to numbers.

Based on the above a general probability model was developed as follows:
P(Shocki=1/x'i β)= F(x'i β). Where ***F(.)*** is a standard normal cumulative distribution function. The vector of covariates ***F(xi')*** of (Physical, Financial, Social, Human and Natural assets, Number of members of household employed, Gender of main earner or dominant person at the point of decision making, and Locality) as discrete variables
Then the marginal effect of shock will be estimated as $\frac{\partial P(Shock=1|x)}{x_j} = f\left(\sqrt{2\Pi}\right)^{-\frac{1}{2}} \exp\left\{-\frac{1}{2}z^2\right\}$

Furthermore, another set of data was collected in peak year of infestation (yr. 2002) using semi-structured interview. It was put into qualitative analysis of livelihood impact using SLI. For this, Sustainable Livelihood Framework (SLI) of DFID (2005) was employed. The difference between the potential and achieved livelihood of households was used to estimate the gap, measured by finding the difference between the area of two pentagons [pentagon formed of potential livelihood capitals (Pp) and pentagon formed of achieved livelihood capitals (Pa)] as shown in Figure 1. Additionally, for estimating the control costs, public documents from 1998-2008 were compiled and data was tabulated.

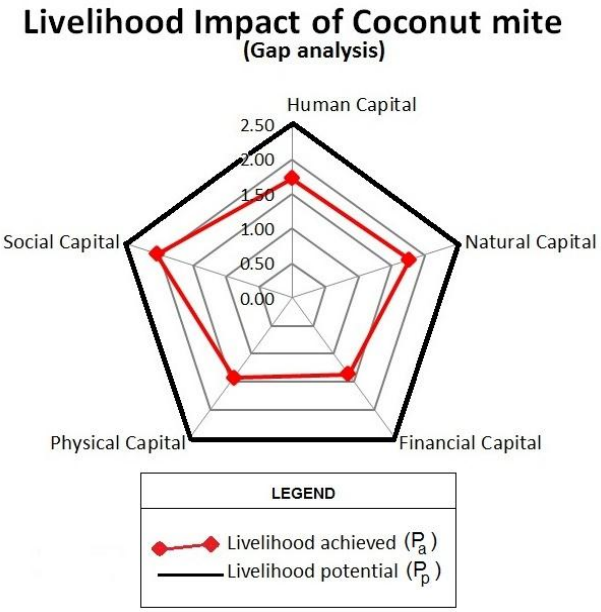

Fig.1

Results and Discussion

The results are divided into (1) Socioeconomic impact and (2) Livelihood impact. The results of the descriptive statistics are given in Table 1.

Socioeconomic impact

The sudden outbreak of *Aceria* mites in coconut plantations has threatened the very survival of the copra industry in South India. Severe infestation of *Aceria* mites during early stages of nut inflicted damage

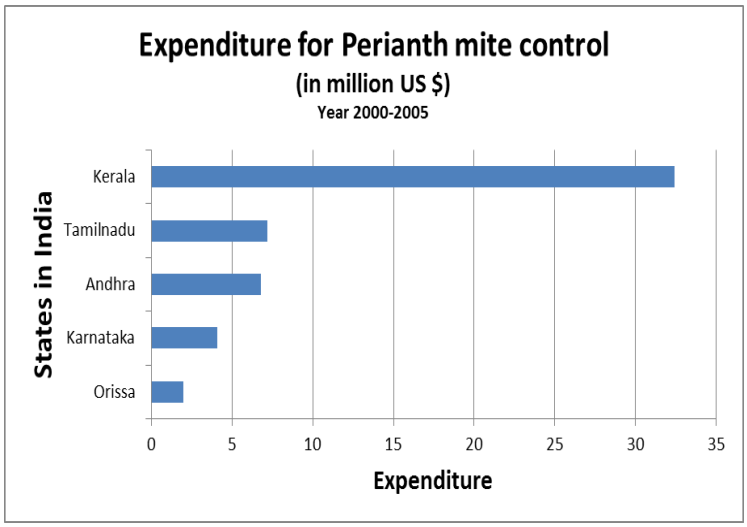

Fig.3


Fig. 2

to the tender tissues and copra, size reduction, shedding of button and heavy yield loss. According to the Central Government Expert Committee Survey (2002), the percentage infestation of mites in various states of India was as follows: Tamil Nadu 40 - 50 %; in Karnataka 25- 30 % and in Andhra Pradesh 10 - 20%. In Kerala state, 90 % coconut palms in 1.2 million was affected during 1998 (Sathiamma et al. 1998). The warting and thickening of epicarp (Fig. 2) by the pest damage not only affects the quality and quantity of the coconut fibre but also causes

difficulty and delay in dehusking operations, which requires additional labour (Pushpa, 2006). Besides these, mite infested under sized nuts are often discarded by the traders (Pushpa, 2006) inflicting heavy losses to the growers. Loss of 20–30% in terms of copra yield (Moore et al. 1989) severely affected the coconut oil industry. In Kerala alone, more than 1.5 million coconut growers were affected by the infestation (Sathiamma et al. 1998), accounted for annual economic loss of 0.3 million US $ (The Indian Express, 1999). Apart from the direct economic loss, various authorities under the central and state governments in India spend enormous amounts for the control and management of the mite. Expenditure incurred by various states in India for mite control is explained in the Figure 3. According to the present study, compiled data evidence showed that Indian government and various agencies incurred control costs of US $ 77.88 million to manage coconut mite in India for a 10-year period from 1998–2008.

Livelihood impact

Gap analysis using SLI showed a difference of 56.26% between the potential and achieved livelihood in studied villages. Social, physical and natural capitals were found very significant in explaining the incidence of livelihood shock as shown in Table 2. It is 21 % less likely for a household that owns any form of physical asset to experience an adverse livelihood shock than for a non-ownership household. While it was found that the specific types of social networks such as, women's networks like Kudumbashree and Self Help Group membership proved significant in averting household shock incidence. Interestingly, women headed households were more likely to avoid livelihood shocks (18 %). In such households, women were found to engage in alternative livelihood activities such as banana chips, spices and condiments processing and tailoring. Such off-farm income might have helped these households to avert coconut mite induced livelihood shock. Besides, triangulating these results with farmers' perception analysis (Fig. 4) also complimented these findings. Around 67 % farm households perceived that their financial capital turned out to be poor compared to pre-mite impact period. The post impact reduction of financial capital may be largely due to the loss of farm income from coconut production. A majority of the farm households were forced to sell their physical assets (cycle, livestock etc.) during the impact period and post impact period. This may be the reason for 64% farm households to perceive that their financial capital was poor during the periods of mite infestation.

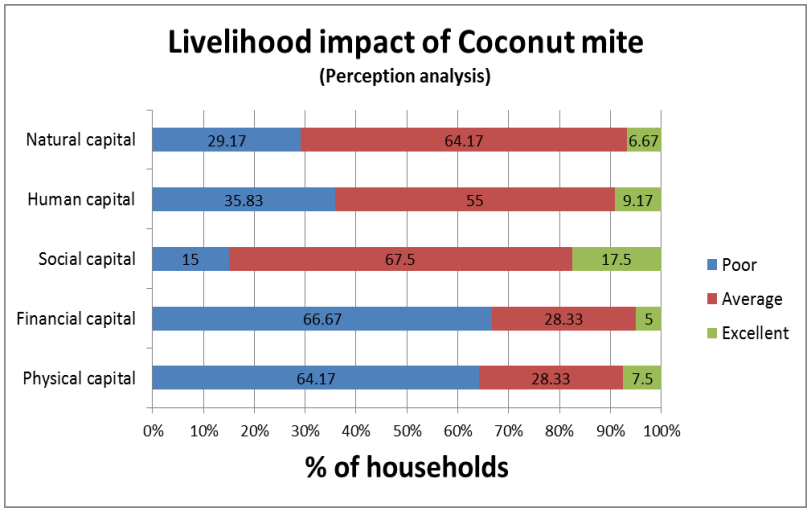

Fig.4

Conclusions and Outlook

With the increase in global trade, invasive species such as *Aceria guerreronis* are gaining more and more prominence around the world. Thus proper quarantine measures must be adopted to prevent the entry of invasive species to an exotic environment in the age of globalisation and market economy. On the other hand, infestation by the invasive *Aceria guerreronis* mite had severe economic impact on coconut plantations in India from 1998-2005. Integrated Pest Management against coconut mite was found successful in India as evidenced by infestation reduction since 2006.Multiple social networks, size of land holding, gender and physical capital

was found to reduce livelihood shocks from coconut mite. Considerable losses through mite damage and control costs were evident in the country. Despite the growing evidence of the economic impacts of invasive species, the level of awareness amongst decision-makers is still relatively low in emerging economies like India. It is therefore critical that informed decision-making regarding the prevention, eradication and control of invasive species be developed.

Table 1. Summary statistics of village level survey

Sl. No.	Parameters	Panchayats	
		Kuttiadi [N=60]	**Kunnummal** [N=60]
1.	Area* (km2)	15.22	10.58
2.	Population* (Nos.)	17108	16870
3.	Farmers* (male)	207	189
4.	Farmers* (female)	11	3
5.	Household size (Nos.)	5.49 (5.91)	6.18 (4.25)
6.	Age (yrs)	42.12 (11.15)	47.07 (12.81)
7.	Education (yrs)	10.63 (4.12)	10.21 (4.89)
8.	Average landholding (ha)	0.48 (2.09)	0.27 (6.03)
9.	Annual income (Rs./annum)	41160.06 (3.23)	40234.75 (3.98)
10.	Productivity of coconut(nuts/ha)	5829.68 (4.26)	5432.63 (4.59)
11.	Coconut area* (ha)	690.34	480.04

Figures in parentheses show standard deviation of sample mean. N stands for the sample size. 1 US$ = Rs. 46.62 (monthly average in September 2009)
Source: Village level census and survey (2008), *JDA office, Kozhikode

Table 2. (Dependent variable – likelihood of incidence of shock

Covariates	*∂shock/∂x*	*Z-value*
Dummy variable for Social capital	*0.287**	5.31
Dummy variable for Physical capital	*-0.123**	-3.07
Number of literate member of household and IPM awareness (Human capital)	*0.114**	0.43
Family landholding (Natural capital)	*-0.005*	-0.09
Savings (Financial capital)	*-.003***	-1.61
Number of household members employed	*-0.063***	-1.32
Household per capita expenditure (monthly)	*0.024*	0.88
Gender of main earner	*0.198****	1.79
Constant	*-1.07***	-1.62

Number of observations (N=120), Number of duplications =4
Pseudo R2 = 0.1415, *** Significant at 1%, **Significant at 5%, * Significant at 10%

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