Socio-economic determinants and adoption of pest management practices in cashew farming: A study in Dakshina Kannada, Karnataka

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Socio-economic determinants and adoption of pest management practices in cashew farming: A study in Dakshina Kannada, Karnataka

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Abstract

The existing technology utilization status and its socio-personal and economic determinants with respect to adoption of recommended pest management technologies were studied among cashew farmers in Dakshina Kannada district of Karnataka by using an 'ex-post-facto cause to effect' design. The findings denoted poor adoption index (20) with particularly high non-adoption for pest management of cashew stem and root borer (CSRB). The correlation analysis identified seven variables *viz.,* farming experience (years), extension participation, importance given to cashew crop, number of yielding cashew trees, expenditure incurred in agriculture, net income from agriculture and net income from cashew farming as having significant relationship with farmers' adoption of pest management technologies. The regression analysis revealed three variables, the age of cashew farmer, their primary occupation and farm size as contributing significantly in explaining the adoption of pest management technologies. The variables used in the study could together explain up to 60 per cent variability in adoption of pest management technologies. The stepwise regression model developed to predict adoption rate of pest management practices explained up to 46.4 per cent of the variation in adoption of pest management technologies using the predictors; number of cashew trees (X1), years of experience in farming (X2), ICT usage (X3), primary occupation of farmer(X4), income from agriculture (X5) and age of the farmer (X6). Understanding the technology utilization process in cashew can help researchers and development agencies working in cashew sector to evolve better technologies for pest management.

Keywords: Adoption, cashew farmers, pest management technologies, socio-economic determinants

Introduction

Cashew (*Anacardium occidentale* L.) is grown in around 28 countries in the world, scattered around Asia, Africa and Latin America. The average global productivity of cashew is about 500 kg ha^{-1} while in India it is about 650 kg ha^{-1}. Beginning largely as a neglected crop, it ends up as a favourite snack food all over the world. Advancements in propagation, production, management and mechanized processing gained cashew the status of a commercial crop. Ever increasing demand for raw cashew nuts and enhanced interest for commercialization have made this change possible in cashew sector (Venkattakumar, 2009). Cashew trees can be grown in fairly poor soils with relatively low rainfall, as long as there is a clear dry season of two to four months. These attributes, plus the facts that little capital requirement for orchard establishment and that low nut perishability minimises the coordination requirements for post-harvest activities, have given cashew the reputation of being a "poor man's" crop (Jaffee, 1995).

In India, cashew cultivation is mainly confined to Kerala, Karnataka, Maharashtra and Goa along the West Coast, and Tamil Nadu, Andhra Pradesh, Orissa and West Bengal along the East Coast region. It is also cultivated in Chhattisgarh, Jharkhand, Gujarat, Bihar and northeast hill regions like Meghalaya, Manipur and Tripura and also in Andaman and Nicobar Islands (DCR, 2011). In India, area coverage under this crop is 10.4 lakh ha with a production of 6.7 lakh

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tonnes and productivity of 650 kg ha^{-1} (DCCD, 2016). India boasts the maximum area (21.6%) under cashew nut and is the third largest producer (17.3%) of raw nuts in the world. After Vietnam, India is the second largest exporter, accounting for 34 per cent of the world's export of cashew kernels. On account of its cheap and skilled labour force, India holds a comparative advantage in the production and processing of cashew nuts. There are 3650 cashew processing industries in the country (both organized and unorganized sectors together), with an installed processing capacity of 15 lakh tonnes, for which the indigenous production contributes only 38 per cent (Shalini, 2010).

Presently, cashew cultivation receives dwindling importance in response to the price fluctuations in case of other plantation crops like arecanut, cocoa, rubber and coconut (Venkattakumar and Bhat, 2003), because of which, Cashew farmers in the region are shifting to rubber plantations and other more remunerative cash crops (Ganapathi and Akash, 2013). In cashew, tea mosquito bug (TMB) and cashew stem and root borers (CSRB) are the two major pests leading to significant crop loss (DCR, 2014). While attack by TMB leads to nearly 40 per cent yield loss, CSRB attack leads to death of the tree itself. Several studies had identified the poor adoption of cashew production technologies including plant protection technologies in this region (Sajeev *et al.,* 2014a, b; Sajeev *et al.,* 2015; Sajeev and Saroj, 2015; Sajeev and Meera Manjusha, 2016). To improve the cashew cultivation scenario in the major cashew-growing regions, assessment of the technology adoption status with respect to recommended pest management measures and factors that contribute to their adoption are very important. To explore the technology adoption of plant protection measures in cashew cultivation, a study was undertaken that measured the utilization of recommended pest management technologies, identified the socio-economic determinants of adoption of pest management technologies and provided a model predicting adoption of pest management technologies.

Materials and methods

The study was conducted by ICAR-Directorate of Cashew Research, Puttur as part of the project 'Impact of Cashew Production Technologies on Area, Production and Productivity of Cashew'. Purposive sampling technique was used to select Dakshina Kannada district of West Coast, since, it is a major cashew producing area of Karnataka with the presence of two research stations besides other development departments working on cashew and hence having better probability of technology utilization at farm level. Cashew production in this district was found contributing largely for the Karnataka state's production (Dixit *et al.,* 1998). Farmers from all the five taluks of the Dakshina Kannada district namely Mangalore, Bantwal, Puttur, Belthangady and Sullia represented the sample.

In the present study, the researchers had no option to manipulate the independent variables, as these had already occurred. Inferences on the relationships between independent and dependent variables had to be drawn on the basis of effects already manifested. Hence an 'ex-post-facto cause to effect' design was applied. The non-manipulable variables that were already evident formed the presumed cause (independent variables).

An interview schedule measuring the adoption status of the farmers, along with their profiles, was developed. The schedule was pre-tested on a group equivalent in size to 10 per cent of the sample used in the subsequent research. Based on the results, the schedule was structured, sharpened and standardized. The content validity was ensured by examining the responses for appropriateness and through subsequent discussion with the researchers working on impact analysis at various institutes under the Indian Council of Agricultural Research. Detailed pre-tested interview schedule was administered to 75 randomly selected respondents. The data were collected during March to April, 2013 through questionnaire and personal interviews. The 12 personal variables and 10 economic variables measured for the study are discussed separately for better comprehension. Correlation and regression analysis were employed to ascertain the relationship between adoption and socio-economic variables and their contribution in explaining the variability in adoption respectively.

Results and discussion

The socio-economic determinants of adoption of pest management technologies and the adoption status of recommended pest management technologies are discussed here to arrive at conclusions.

Socio-personal profile of cashew farmers

The study of personal variables furnished in Table 1 shows that cashew farmers were equally distributed with mean age of 47 years. Majority were high school pass outs (45%) with 93 per cent having agriculture as their primary occupation. Most farmers (48%) had medium level of experience (average of 23.5 years) in agriculture. These findings are similar as of Lakshmisha (2000), Shivaramu *et al.,* (2004), Veerkar *et al.,* (2006) and Venkattakumar (2006, 2008, 2009). Majority (41%) reported low experience (average of only 10.5 years) in cashew farming as found in earlier study of Venkattakumar (2006) but contrasting with studies conducted by Veerkar *et al.,* (2006) in same region.

Table 1. Personal profile of cashew farmers (n=75)

Independent variables	Mean	SD	Category	Respondents	
				f	%
Age	46.5	12.93	Young	24	32
			Middle age	25	33
			Old	26	35
Level of education	3.8	1.19	Illiterate	3	4
			Primary	11	15
			Secondary	7	9
			High School	34	45
			PUC	4	5
			Degree	11	15
			PG	5	7
Primary occupation			Agriculture	70	93
			Others	5	7
Experience in farming	23.5	13.54	Low	21	28
			Medium	36	48
			High	18	24
Experience in cashew farming	10.5	7.24	Low	31	41
			Medium	23	31
			High	21	28
Extension contact	3.03	6.29	Low	51	68
			Medium	17	23
			High	7	9
Extension participation	6.7	7.36	Low	15	20
			Medium	48	64
			High	12	16
ICT usage	10.0	5.90	Low	17	23
			Medium	42	56
			High	16	21
Cosmopoliteness	7.8	5.13	Low	27	36
			Medium	27	36
			High	21	28
Land used for cashew			Fully irrigated	2	3
			Partially irrigated	5	7
			Rain-fed/un-irrigated	68	90
Land used for other crops			Fully irrigated	57	76
			Partially irrigated	8	11
			Rain-fed/un-irrigated	10	13
Distance of cashew plot from home	427	850	Less	2	3
			Moderate	60	80
			Large	13	17

Contact with extension agencies was found to be low among majority of cashew farmers (68%) while extension participation was found to be medium for almost two-third of the farmers (64%) like that of reports by Lakshmisha (2000) and Shivaramu *et al.,* (2004). More than half of the cashew farmers (56%) exhibited medium levels of ICT usage while, majority were equally divided into low and medium categories (36%). In case of cosmopoliteness, our findings contradict with that of Lakshmisha (2000), Shivaramu *et al.,* (2004) and Venkattakumar (2006). While three-fourth majorities (76%) of cashew farmers were giving irrigation for other crops grown by them, large majority (90%) of them cultivated cashew under rainfed system only. The average distance of cashew plots from farmers' homes were found to be around half a kilometer (427 meters).

Economic profile of cashew farmers

Economic profile of cashew farmers as presented in Table 2 shows that around half of the farmers grew 3-4 crops on an average in their farms. But three-fourth of the farmers (72%) gave least priority to cashew farming. Venkattakumar (2008) had made similar observation. The average farm size was found to be 1.9 acres while average area of un-used land available for cultivation was about 86 cents. Majority (55%) of farmers had no or negligible amount of unused land available for furthering cultivation. Households under study had an average of 173 cashew trees giving a mean yield of 2.92 kg tree^{-1}. More than half of the cashew farmers (55%) realized only moderate yields with an average net income of 29,664 ha^{-1} year^{-1} against an average expenditure of 9293 ha^{-1} year^{-1}. Majority

Table 2. Personal profile of cashew farmers (n=75)

Independent variables	Mean	SD	Category	Respondents	
				f	%
No. of crops grown	3.3	1.62	Less	20	27
			Moderate	36	48
			High	19	25
Importance given to cashew	1.6	1.0	Least	54	72
			Moderate	8	11
			High	11	14
			Highest/first priority	2	3
Farm size	1.9	0.82	Low	31	41
			Medium	23	31
			High	21	28
Cultivable land available	0.9	1.29	No / Negligible	41	55
			Medium	20	27
			High	14	18
No. of yielding cashew trees	173	220	Low	26	35
			Medium	38	51
			High	11	14
Yield of cashew per tree	2.5	2.1	Low	21	28
			Moderate	41	55
			High	13	17
Expenditure in agriculture	90981	64037	Low	35	46
			Medium	20	27
			High	20	27
Net income from agriculture	240540	149649	Low	37	49
			Medium	20	27
			High	18	24
Expenditure in cashew farming	9293	11028	Low	28	37
			Medium	31	41
			High	16	21
Net income from cashew farming	29664	70426	Low	29	39
			Medium	40	53
			High	6	8

(46%) made low levels of yearly investment in agriculture of 90,981 ha^{-1} year^{-1}gaining a net income of ₹ 2,40,540 ha^{-1} year^{-1}.

Adoption status of recommended pest management technologies

The adoption of pest management technologies was quantified by measuring the farmer's ability to identify the symptoms of TMB and CSRB attack, status of TMB and CSRB attack in farmer fields, application of recommended chemical in correct dose, adoption of phyto-sanitation measures and adoption of other recommended management measures. Pest management, an important component in cashew production, scored a very low overall adoption index (20) in the present study. Farmers were equally distributed among high, medium and low adopter categories while 17 per cent of cashew farmers reported complete non-adoption of any recommended pest management measures (Table 3).

Table 3. Overall adoption levels of recommended pest management technologies (n = 75)

Adoption Index	S.D.	% farmers under various levels of adoption			
		High	Medium	Low	Non-adoption
20	19.2	29	26	28	17

Adoption of pest management technology by cashew farmers

The results revealed that in case of TMB, 30 per cent of the farmers could always identify initial attack symptoms in their orchard while majorities (63%) were never able to do the same (Table 4). Similarly, while 26 per cent of the farmers took up spraying against TMB in the flushing or flower initiation stages, majority (65%) never did any spraying in their orchards. Although 30 per cent of the farmers followed recommendations regarding spraying the recommended chemicals (Monocrotophos/Karate), only 24 per cent adhered to the recommended dosage of the chemical. It may be noted that nearly two-third of the farmers didn't spray the recommended chemicals while almost three-fourth majority overlooked the recommended dosage. Monitoring for renewed TMB attack was done by nearly one-third (32%) of the farmers while 63 per cent never did the activity.

In case of CSRB management, 35 per cent of the farmers could always identify initial symptoms of CSRB attack in their orchards while 60 per cent were unable to do so. However, 90 per cent of the farmers never attempted removing grubs from CSRB affected trees. With respect to practices like chiseling out the affected bark, application of chlorpyriphos to chiseled portion and soil and application of chlorpyriphos in recommended dose, 79 per cent of the farmers never attempted these measures with extremely low adoption (8%, 9% and 9%, respectively). Earlier reports of Nirban and Sawant (2000) and Zagade *et al.,* (2000, 2003) support above findings, but shows contrast with findings by Venkattakumar (2009). However, earlier studies by Venkattakumar *et al*. (2005) show that 90 per cent of demonstration farmers who availed subsidies were found to adopt pest management measures.

Table 4. Adoption of pest management measures in cashew (n=75)

Sl. No.	Recommended pest management measures	Adoption by cashew farmers					
		Always/Fully		Sometimes/Partially		Never/Non-adoption	
		f	%	f	%	f	%
1.	Identifying initial symptoms of TMB attack	23	30	5	7	47	63
2.	Spraying against TMB at recommended time	19	26	7	9	49	65
3.	Spraying of recommended chemical	23	30	4	5	48	65
4.	Spraying of pesticide in recommended dose	18	24	2	3	55	73
5.	Monitoring for renewed TMB attack	24	32	4	5	47	63
6.	Identifying initial symptoms of CSRB attack	26	35	4	5	45	60
7.	Removal of grubs from CSRB affected trees	2	3	5	7	68	90
8.	Chiseling out the affected bark	6	8	10	13	59	79
9.	Application of recommended pesticide	7	9	9	12	59	79
10.	Application of pesticide in recommended dose	7	9	9	12	59	79

Non-adoption was particularly high for pest management technologies against CSRB due to the complexity of the recommended technology while majority of the farmers had adopted measures against TMB. This is due to less complexity, higher trialability and observability of results with respect to TMB management technologies in comparison to measures recommended against CSRB. Dixit and Bhaskara Rao (1999) and Venkattakumar *et al*. (2005) also reported farmer responses indicating that recommended control measures could not check attack of CSRB explaining poor adoption rates of pest management technology as a whole. The findings show that there is tremendous scope in the region for outreach of recommended pest management technologies in cashew.

Earlier studies show that pest management component while scoring lowest adoption index also emerged as the most significant contributor towards cashew production in Dakshina Kannada district (Sajeev *et al.*, 2014a, Sajeev and Saroj, 2014). This clearly indicates that adoption of plant protection techniques cannot be ignored at any cost if cashew production in the district has to be improved. The findings also calls for development of plant protection measures which are user friendly (less complex), having relative advantage over existing technologies and also compatible with farmer situations.

Socio-economic determinants of farm level adoption of pest management technologies

Relationship between adoption and socio-personal variables and their contribution towards adoption of pest management technologies have been studied. Correlation analysis identified two socio-personal variables *viz.,* years of experience in farming and extension participation of cashew farmers as having a significant relationship with farmers' adoption of pest management technologies. The regression analysis identified two variables *viz.,* the age of cashew farmer and their primary occupation with significant positive contribution towards adoption (Table 5).

Table 5. Relationship between adoption and socio-personal variables and their contribution in explaining the variability in adoption of pest management technologies (n=75)

Sl. No.	Socio-personal variables	'r' value	'b' value
1.	Age	0.146 NS	-0.609**
2.	Level of education	-0.096NS	-0.154 NS
3.	Primary occupation	-0.155 NS	-0.305 *
4.	Experience in farming	0.356**	0.779NS
5.	Experience in cashew farming	0.180NS	-0.074 NS
6.	Extension contact	0.189 NS	0.217 NS
7.	Extension participation	0.248*	-0.018NS
8.	ICT usage	0.217 NS	0.209 NS
9.	Cosmopoliteness	0.158 NS	0.009 NS
10.	Land used for cashew	0.001 NS	-0.129NS
11.	Land used for other crops	0.066 NS	0.002 NS
12.	Distance of cashew plot from home	-0.135 NS	-0.036NS

R^2 = 0.600; NS – Non-Significant, ** - Significant at 1 % level, * - Significant at 5 % level

Relationship between adoption and economic variables and their contribution to adoption of pest management technologies

Five economic variables *viz*., importance given to cashew, number of yielding cashew trees, expenditure in agriculture, net income from agriculture and net income from cashew farming were having significant relationship with adoption of pest management technologies. The regression analysis identified one variable *i.e.,* the farm size, as exerting a significant positive contribution towards explaining the variability in adoption of pest management technologies (Table 6).

Table 6. Relationship between adoption and economic variables and their contribution in explaining the variability in adoption of pest management technologies (n=75)

Sl. No.	Economic variables	'r' value	'b' value
1.	No: of crops grown	-0.180NS	-0.029 NS
2.	Importance given to cashew	0.246*	-0.273 NS
3.	Farm size	0.123 NS	0.259*
4.	Area under cashew	-0.023NS	-0.254 NS
5.	No. of yielding cashew trees	0.433**	0.198NS
6.	Yield of cashew per tree	0.146 NS	0.052 NS
7.	Expenditure in agriculture	0.377**	-0.081 NS
8.	Net income from agriculture	0.340**	0.237 NS
9.	Expenditure in cashew farming	0.183 NS	0.387 NS
10.	Net income from cashew farming	0.333*	0.227 NS

R^2 = 0.600 NS – Non-significant, ** - Significant at 1 % level, * - Significant at 5 % level

The socio-personal and economic variables used in the study could together explain up to 60 per cent variability in adoption of pest management technologies ($R^2 = 0.600$).

Predicting adoption of pest management technologies: Step-wise regression models

Stepwise regression was used to check the extent to which the selected models explained the variation in adoption of pest management technologies. In this analysis, six models were tested to examine the variation in adoption among the respondents (Table 7). Model 6 explained up to 46.4 per cent of the variation in adoption of pest management technologies (PPT AI) using the predictors; number of cashew trees (X1), years of experience in farming (X2), ICT usage (X3), primary occupation of farmer (X4), income from agriculture (X5) and age of the farmer (X6) (Table 6). The model 6 also had the lowest standard error of the estimate (14.7176) thus making it the best model suited to predict adoption of pest management technologies by farmers. The model is fitted as: *PPT AI: 40.579 + 0.028 X1 + 0.808 X2 + 0.737 X3 - 19.167 X4 + 1.916E-005 X 5 - 0.412 X6*. This model can be used for prediction of adoption of pest management technologies by farmers under similar agro-ecological situations.

While analysing the existing status of technology utilization in pest management by cashew growers in Dakshina Kannada district of Karnataka, it was revealed that majority of cashew farmers had low levels of utilisation status with respect to pest management technologies. This is a matter of huge concern since cashew yields are largely influenced by the attack of TMB while attack of CSRB eliminates the crop itself. Strategic measures have to be taken to improve the utilisation of pest management technologies in this region as an element of the foundation for technology adoption and change in

Table 7. Models predicting adoption of pest management technologies: Step-wise regression analysis

Coefficients[a]					
Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. error	Beta		
(Constant)	40.579	15.104		2.687	0.009
CSHWTRS (X1)	0.028	0.009	0.323	3.247	0.002
FRMNGEXP (X2)	0.808	0.190	0.562	4.262	0.000
ICTU (X3)	0.737	0.297	0.227	2.478	0.016
OCCPN (X4)	-19.167	7.078	-0.251	-2.708	0.009
INCM (X5)	1.916E-005	0.000	0.232	2.392	0.020
AGE (X6)	-.412	0.200	-0.275	-2.064	0.043

a. Dependent variable: PPT AI
B. ***PPT AI: 40.579 + 0.028 X1 + 0.808 X2 + 0.737 X3 - 19.167 X4 + 1.916E-005 X5 - 0.412 X6***

Model Summary				
Model	R	R^2	Adjusted R^2	Std. error of the estimate
1.	0.426[a]	0.181	0.170	17.54934
2.	0.497[b]	0.247	0.226	16.95022
3.	0.573[c]	0.328	0.300	16.12057
4.	0.615[d]	0.378	0.342	15.62482
5.	0.656[e]	0.430	0.388	15.06636
6.	0.681[f]	0.464	0.416	14.71760

a. Predictors: (Constant), CSHWTRS
b. Predictors: (Constant), CSHWTRS, FRMNGEXP
c. Predictors: (Constant), CSHWTRS, FRMNGEXP, ICTU
d. Predictors: (Constant), CSHWTRS, FRMNGEXP, ICTU, OCCPN
e. Predictors: (Constant), CSHWTRS, FRMNGEXP, ICTU, OCCPN, INCM
f. Predictors: (Constant), CSHWTRS, FRMNGEXP, ICTU, OCCPN, INCM, AGE

pest management sector. The findings will guide research and extension agencies in undertaking targeted efforts for improving technology application among cashew farmers aimed at sustainable adoption of pest management technologies.

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