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Identification of factors affecting decision-making of cauliflower farmers on adoption of integrated pest management technology

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Abstract
A logit model was used to identify the factors that affect the adoption of Integrated Pest Management (IPM) technology by the farmers growing cauliflower in the state of Haryana, India. The changes in probability as influenced by the changes in different factors were also determined by the odds ratio. On the basis of both parameter estimates as well as odds ratio, it was observed that income from vegetables and area under vegetable cultivation were the most important and decisive factors influencing positively the adoption of IPM technology in cauliflower, whereas cropping intensity, lack of education and social backwardness were the factors which adversely affected the adoption of IPM in cauliflower cultivation.

Keywords: IPM - determinants, integrated pest management (IPM) technology, factors affecting IPM adoption, logit model

Introduction
Cauliflower continues to be an important vegetable crop for farmers in India, because of its demand in fresh and green vegetable market. With the total acreage of 0.35 million hectares and a production of 6.5 million tons, cauliflower is the fifth important vegetable crop after potato, onion, tomato, egg plant and okra. But this crop is infested with many insect pests and diseases. During the past several years, the tobacco caterpillar (*Spodoptera litura)* has been identified as major insect of cauliflower and most difficult to control along with cabbage head borer (*H. undallis*,) alternaria leaf spot and damping off (Ahuja *et al*. 2012) [1]. Most growers continue to

spray 10-12 pesticide applications for this rainy season crop which lasts for a period of 4 months, from June to mid - October (Weinberger and Srinivasan 2009) [14]. High frequency of pesticide application results in more pesticide residual amounts above the maximum residue limit value (Cesnik *et al*. 2009) [6]. Further more, the pest control approach being followed by the farmers currently is focused on application of such insecticides which are not only highly toxic but also to which *Spodoptera litura* has developed resistance (Ashvinder Kaur *et al*. 2006) [3]. These compel the farmer for a higher frequency of insecticide application. There are many promising technologies that have shown good results for management of individual pest problems, and which have been put to practice together in a comprehensive manner as integrated pest management (Ahuja *et al*. 2013) [2] and found economically viable. The adoption of IPM not only could overcome indiscriminate pesticide usage effects but also has been commended for its role in increasing farm production, net farm incomes and environmental benefits. Adoption of technological innovations in agriculture has attracted considerable attention among development economists (Feder *et al*. 1984) [8]. Adoption is a logical end to the process of technology development. Unless the technology is adopted by the farmers, the gains from the innovations can not be realized and investments that go into the technology development can not be justified. An understanding of the adoption behaviour of farmers can help in targeting research and technology on one hand and planning for effective extension on the other. However, despite its several benefits, the adoption of IPM technology has only been limited. Therefore, the present study has attempted to investigate what are the factors that affect the farmers' decision to adopt pest management practices in cauliflower cultivation

Objectives: The specific objectives of the study included
1. To identify the factors that affect adoption of IPM practices in cauliflower cultivation

2. To estimate the relative contribution of each factor in affecting IPM adoption and
3. To highlight the factors that have a major impact on technology adoption.

Methodology and data collection

Study Area

For this study, the Palari village of Sonipat district in the state of Haryana (India) situated at a distance of 50 km from New Delhi was selected.

Data collection

Data relating to farm production and other socio- economic variables for the year 2009-10 were collected from a random sample of 66 farmers comprising 40 adopters and 26 non-adopters of IPM. The data were collected using pre-tested schedules by personal interview. A few random visits were also made to crop fields with biological scientist working there on IPM. Farmers were asked questions related to the socio-economic profile and farming like educational level, operational size of landholding, experience in vegetable growing, cropping system, cauliflower cultivation practices, extension contacts, source of inputs, farmer's knowledge regarding the pests, assessment of losses due to the pest, natural enemies and their role in pest regulation, type of pest equipment used, pest control advise and mass media exposure.

Analytical procedure

To identify the factors that influence the adoption of IPM technology, the logistic model was fitted. The decision on adoption and non–adoption of plant protection measures essentially takes the form of a binary variable and therefore, can be analysed with either logit or probit model (Harper *et al*. 1990) [11]. The choice between these two models is largely a question of convenience (Hanushek and Jackson 1971) [10]. In the logistic regression, the parameters of the model are estimated using the maximum likelihood method, i.e. the coefficient that makes the observed results most likely is selected. The logistic coefficients can be interpreted as a change in log odds associated with one unit change in the independent variable. Since, the logistic regression model is non-linear; an alternative algorithm was used for parameter estimation. The goodness of fit of the model is tested by using the Chi-square, which is comparable to the overall F-test for regression.

In the present study, it was hypothesized that the probability of a farmer adopting the IPM technology depends on area under vegetable cultivation, increase in net income due to adoption of a technology, age and education level of house hold-head, number of family members, family structure, total cropped area, cropping intensity, source of information and social groups.

The following logit model was estimated to predict the probability that a farmer would adopt IPM in cauliflower cultivation:

$$Y = g(Z) \quad \ldots (1)$$

$$Z = F(X_1, X_2, X_3 \ldots X_k) \quad \ldots (2)$$

where,

Y = Adoption state of a household (1 for the adopter, and 0, for non-adopter)

Z = Vector of explanatory variables.

K = Total number of explanatory variables, and

$X_1, X_2, X_3 \ldots X_k$ = Explanatory variables.

K = Total number of Explanatory variables.

In fact, Z in the logit model postulates that P the probability of adoption of the IPM is a function of an index variable Z, summarizing a set of the explanatory variables. In fact, Z is equal to the logarithm of the ratio, i.e. ratio of probability of adoption of the IPM by the households the probability of non-adoption and it can be estimated as liner function of explanatory variable (X_k). It can be expressed as:

$P = 1/1+e^{-z}$ this represents the (cumulative) logistic distribution (Gujarati 1988).

$1\text{-}P = 1/1+ eZ$, or

$$\frac{-P}{1-P} \quad \frac{1+eZ}{1+e\text{-}Z} = eZ \text{ or, } Ln(P/1\text{-}P) = F(X_1, X_2, X_3, \ldots X_k) \quad \ldots (3)$$

Once Equation (3) is estimated, the factors influencing adoption can be ascertained.

Specification of the variable used in the logit model

The specification of the variables and its definition are given below:

Variables Definition / Codes	
Dependant variable (Y)	Y = 1, for an adopter household, Y = 0, if household is non-adopter
Cropping intensity	In Percent
Area under vegetable cultivation	In Acres
Family members	In numbers
Family Structure	1, if Joint, 0 for Nuclear
Income from vegetable cultivation	In Rs/acre
Age of the farmer	In years
Education	0 for illiterate, 1 for primary, 2 for matriculation and 3 for graduation and above
Source of information	Village worker, chemical Shop, KVK
Total cropped area	In hectares
Social groups	

Results and Discussion

The descriptive statistics for the selected variables are summarized in Table 1. Only 26 (39.4%) out of 66 farmers had adopted IPM in cauliflower cultivation and the remaining 40 (60.6%) were non-adopters. The average age of a farmer was about 45 years and literacy rate was only 35 per cent in all the farmers. The average family size was 5.71, ranging from 5.77 for adopters and 5.68 for non -adopters and about

80 per cent farmers were living in joint families. It is evident from Table 1 that socio-economic variables of adopters and non-adopters were more or less same but the farm variables were significantly different. The IPM adopters had a larger area under vegetable cultivation (3.2 acre) as compared to non-adopters (1.27 acre). On an average cropping intensity for all farms was 226.93 per cent. It was less for IPM – adopter than non- adopters. The average annual net income from vegetable cultivation was Rs 72,280 per household ranging from Rs 42250 per household for non- adopters to Rs118479 per household for adopters. The mean values for most of the farm variables are more for adopters than for non-adopters.

Determinants of adoption of IPM using logit modal

Technology adoption in general and IPM in particular depends upon many attributes which in turn are governed by socio-economic and technological factors. To identify the various factors that influenced the adoption of IPM, the binary logistic regression modal was used. The factors/ explanatory variables selected for the model included age of farmer, cropping intensity, vegetable area, number of family members, family structure, income from vegetable cultivation, source of knowledge social group and educational status. The factors influencing IPM adoption in cauliflower cultivation have been presented in Table 2. The estimates of the logit model, which was run to know the impact of explanatory variables on the binary dependent variable, have also been presented in Table 2. To give a more precise explanation, odds ratio, i.e. the ratio of probability of non-adoption of point estimate of the factors influencing adoption was also worked out.

The parameter estimates of the variables of cropping intensity, area under vegetable cultivation, income from vegetables, educational status and social groups were found significant. The estimates of the cropping intensity, illiteracy (educational status) and social group (scheduled caste) were negative -0.005, -2.990, -2.408, respectively, indicating that these factors adversely affected the adoption of technology. The value of odds ratio for these variables was less than unity which implied that probability of adoption was less than of non - adoption. The negative signs for logit coefficients and less than one value of odds ratio for these variables indicated that the farmers growing more crops were less inclined to adopt IPM. Also, illiterate and scheduled caste farmers did not adopt the technology. It implied that at the initial level only educated and higher caste farmers had adopted the technology and therefore with increase in education and awareness about the benefits of IPM, the adoption rate can be increased. The estimates of area under vegetable cultivation and income from vegetables were positive 3.082, 0.009 respectively, implying that with the increase in area under vegetable and rise in income from vegetables the chances of adoption of technology increase. In other words, we can say that as a farmer increases area under vegetables cultivation and his income increases, he is more inclined towards the adoption of IPM technology. The positive signs for the logit coefficients and more than one values of odds ratio for these two variables indicated that these were the two major factors favouring the adoption of IPM technology by the farmers.

Table 1: Descriptive statistics of the selected farm families

Variables		Total farmers (66)		IPM Adopters (26)		Non IMP -Adopters (40)	
		Mean	SD	Mean	SD	Mean	SD
Family details	Joint family (No.)	52.00	78.79	20.00	77.00	32.00	80.00
	Nuclear (No.)	14.00	21.21	6.00	23.00	8.00	20.00
	Age of farmers (years)	44.73	12.22	44.92	11.69	44.60	12.70
	No. of family members	5.71	1.59	5.77	1.66	5.68	1.56
Educational status	Illiterate (No.)	44.00	66.67	17.00	69.23	27.00	67.50
	Primary (No.)	3.00	4.55	1.00	3.85	2.00	5.00
	Middle (No.)	2.00	3.03	1.00	3.85	1.00	2.50
	SSC (No.)	14.00	21.21	6.00	23.08	8.00	20.00
	HSC (No.)	3.00	4.55	1.00	3.85	2.00	5.00
Total		66.00	100.00	26.00	100.00	40.00	100.00
Social Group (Nos. and Percentage)	SC (No.)	11.00	16.67	3.00	11.54	8.00	20.00
	ST (No.)	2.00	3.03	1.00	3.85	1.00	2.50
	OBC (No.)	26.00	39.39	10.00	38.46	16.00	40.00
	General (No.)	27.00	4.091	12.00	46.15	15.00	37.50
Farm information	Total Cropped Area (in acre)	5.68	5.04	6.61	5.47	5.07	4.71
	Vegetable area (in acre)	1.35	1.46	3.20	3.02	1.27	1.40
	Income from vegetables (in Rs)	72280	91474	118479	123226	42250	43174
	Cropping intensity (%)	226.93	188.50	184.00	59.08	254.84	234.43

Table 2: Factors influencing adoption of IPM technology in vegetables cultivation in Sonipat district of Haryana

Particulars	Odds Ratio	Coefficient	Z-Statistic	P-Value
Cropping intensity	0.995	-0.005	-1.32^	0.188
Vegetable area	21.800	3.082	2.52**	0.012
Family members	0.813	-0.207	-0.730	0.466
Family structure				
Joint family	0.716	-0.333	-0.290	0.770
Total Cropped Area	1.094	0.089	0.460	0.645
Income from vegetable	1.000	0.000	2.83*	0.005
Source of information				
Village worker	0.651	-0.429	-0.410	0.648
Agro-chemical shop	0.399	-0.917	-0.65	0.515
Krishi Vigyan Kendra	0.252	-1.377	-1.210	0.225
Social group				
Scheduled castes	0.090	-2.408	-1.53^	0.127
Scheduled castes	0.091	-2.393	-0.57	0.570
Other backward classes	0.494	-0.704	-0.710	0.447
Age	1.002	-0.003	0.060	0.950
Educational status				
Illiterate	0.050	-2.990	-1.77***	0.077
Chi square	38.960			0.000
% of correct prediction	89.43			

Note: *, **, ***, ^ denote significance at 1%, 5%, 10% and 20% level respectively

Conclusions

The factors affecting farmers' decision on adoption of IPM technology either to adopt or not to adopt IPM in cauliflower cultivation have been analyzed using logit model. The changes in the probability of adoption associated with the changes in the farm and socio-economic characteristics of the farmer have also been computed. It has been concluded on the basis of estimates of both parameters as well as value of odds ratio that net returns and area under vegetable cultivation are the most important and decisive factors that influence positively the adoption of IPM in cauliflower, whereas cropping intensity, lack of education and backwardness are the factors which adversely affect the adoption of IPM technology in cauliflower. These findings have implications for the policy makers too. These indicate that extension efforts should be planned for educating the farmers about pest incidence and management, and research efforts should be promoted for working out 'easy-to-understand' economic thresholds.

References

1. Ahuja DB, Usha Rani Ahuja, Srinivas P, Singh RV, Meenakshi Malik, Pratibha Sharma, *et al*. Development of farmer-led integrated management of major pests of cauliflower cultivated in rainy season in India. Journal of Agricultural Science. 2012;4(2):79-86.
2. Ahuja DB, Singh S, Sharma P, Malik M, Singh RV, Kalra Bharti. Development and On-farm validation of location specific IPM technology for rainy season cauliflower (*Brassica oleracea* var *botrytis* subvar *cauliflora*). Indian Journal of Agricultural Sciences. 2013;83(2):198-202.
3. Ashwinder Kaur, Kang BK, Balwinder Singh. Monitoring of insecticide resistance in *Spodoptera litura* (Fabricius) in Punjab, India. Pesticide Research Journal. 2006;18(1):51-53.
4. Bagi FS. A logit model of an extension agent's choice to visit individual farms. Canadian Journal of Agricultural Economics. 1984;32:211-220.
5. Balappa Shivaraya, Hugar LB, Hiremath GK. Resource use efficiency in red gram production under integrated pest management technology in Gulbarga district. Karnataka Journal of Agricultural Sciences. 1998;11(3):712-716.
6. Cesnik HB, Gregorcic A, Bolta SV. Plant protection product residues in apples, cauliflower, cereals, grape, lettuce, peas, peppers, potatoes and strawberries of the Slovene origin in 2006. Journal of Central European Agriculture. 2009;10(3):311-320.
7. Deka SC, Burman N, Baruah AALH. Monitoring of pesticide residues in feed, fodder and butter in Assam. Pesticide Research Journal. 2004;16:86-89.
8. Feder G, Just RE, David Zilberman. Adoption of Agricultural Innovation in Developing Countries. World Bank staff working paper No. 542, The World Bank, Washington, USA; c1984. p. 65.
9. Gujarati DN. Basic Econometrics, McGraw Hill Book Company, New Delhi; c1988. p. 705.
10. Hanushek EA, Jackson JE. Statistical Methods for Social Scientists, pp 197. Academic Press, New York; c1971.
11. Harper JK, Edward Rister, Mjilde JW, Bustiaan MD, Way MO. Factors influencing the adoption of Insect Management Technology. American Journal of Agricultural Economics. 1990;72:997-1005.
12. Huffman WE. Black White Human capital differences impact on Agricultural productivity in the US South. American Economic Review. 1981;71:94-107.
13. Katyal JC, Rama Rao CA, Shaik Haffis, Das SK, Reddy YVR. Technological changes in dry farming regions. Indian Journal of Dry land Agricultural Research and Development. 1993;8(2):81-87.
14. Weinberger K, Srinivasan R. Farmer's management of cabbage and cauliflower pests in India and their approaches to crop protection. Journal of Asia Pacific Entomology. 2009;12(40):253-259.