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Social Factors Influencing Adoption of Integrated Pest Management (IPM) Technologies by Paddy Farmers

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Abstract

This study aimed to identify the factors influencing adoption of Integrated Pest Management (IPM) technologies by paddy farmers in Sari County of Iran. A sample of 260 farmers who selected randomly, participated in this study through a survey questionnaire. Findings of the study revealed a statistically significant positive correlation between adoption of IPM technologies and farmers' participation in extension activities, Farmers' Field School, local associations, and influence of opinion leaders. Regression analysis indicated that nearly 43 % of variation in the IPM technologies adoption could be explained by participation in extension activities, local associations, and influence of opinion leaders. Findings have implications for designing extension programs that can encourage adoption of IPM technologies by farmers.

Keywords:
Integrated pest management, Paddy farmer, FFS program, Extension activities

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INTRODUCTION

With population growth, agriculture will need to produce enough supply of food to feed an expected more than eight milliard people by 2030 (FAO, 1992). Hence, it is necessary to decrease crop losses (which pests are one of agents to cause crop losses) in order to increase food safety and access to sustainable agricultural development (Van Huis and Meerman, 1997; Oerke *et al.,* 1994).

Rice is the world's most important food crop and a primary source of food for more than half of the world's population (Khush, 2004). Rice as the most important strategic product of Mazandaran province, with the cultivation size of 201,793 hectares, has the highest amount of rice production in Iran (Ministry of Agricultural Jihad, 2006). Considering chemical pesticides usage in Iran indicates the highest consumption of chemicals in the rice fields. Since pesticides can pose serious threats to human health and the environment (WHO, 1990; citing in Pouratashi and Iravani, 2012), there is the question of how can effectively handle agricultural pests. Integrated Pest Management (IPM) is a pest management strategy that focuses on long-term prevention or suppression of pest problems with minimum impact on environment, human health, and non-target organisms (Louise Flint *et al.,* 2003). IPM applies a combination of practices including biological, chemical, and cultural (Tette *et al.*, 1987). So, it enables farmers to reduce their reliance on pesticides while increasing yields, crop quality, and profitability (Mauceria, 2004). Biological control of pests is one technology of integrated pest management which deals with these issues. National Academy of Sciences (1987) defined biological control as "the application of natural or modified organisms, genes, or gene products to decrease the effects of undesirable organisms (pests), and to favor desirable organisms such as crops, trees, animals, and beneficial insects and microorganisms." In Iran, since 1990s the use of integrated pest management technologies in rice fields of north Iran was started with applying Trychograma bee, and now, by establishing field farmer school (as one of extension-participatory methods), these technologies are introducing to paddy farmers. Farmers are important in the process of adoption and application of IPM technologies. Therefore, it is important to find social factors affecting the adoption of IPM technologies by farmers.

Reviews of Literature

Ferguson (1995) found that participation of farmers in IPM activities affected adoption of not chemical methods and IPM technologies. Muthuraman and Sain (2002) found that lack of knowledge about pest management strategies and lack of community action were among the major barriers in the adoption of IPM technologies by farmers.

Palis *et al.* (2002) found that kin networks, neighborhoods, membership in a farmer's association cause adoption of IPM technologies. Bonabana-Wabbi (2002) indicated that membership in farmers' association had positive effect on level of adoption of IPM practices.

Luther *et al*. (2005) found significant difference between farmers who participated in extension activities and farmer's field schools (FFS) for IPM adoption compared to those who did not participated in these activities. Barrera *et al*. (2005) found that information sources had a positive impact on the adoption of IPM technologies. FFS program was the main determinant in IPM adoption. Other factors were field days, pamphlets, and exposure to FFS-participants.

Asghari and Hadi (2009) found that social participation of farmers, membership in rural associations, participation in extension activities, and communication with extension experts had significant correlation with the adoption of biological control by farmers. Erbaugh *et al.* (2010) found that participation of farmers in farmer field schools (FFS) programs influenced increasing IPM knowledge of farmers. Also, IPM knowledge was the major factor in the adoption of IPM technologies. Noorhosseini Niyaki *et al.* (2010) found that the main important factors of adoption of biological control were farmers education level, family size, experience in rice cul-

Table 1: Summary of social factors influencing adoption of IPM technologies

Variable	Source
Membership in rural- agricultural cooperatives	Asghari and Hadi (2009), Muthuraman and Sain (2002), Noorhosseini Niyaki *et al.* (2010), Palis *et al.* (2002).
Participation in extension-education activities	Asadpour (2011), Bonabana-Wabbi (2002), Boughton and de Faran (1994), Luther *et al.* (2005), Mariyono (2007), Noorhosseini Niyaki *et al.* (2010), Truong Thi (2008),
Participation in FFS programs	Rejaul and Bakshi (2005), Ridgley and Brush (1992).
Participation in local associations	Asai and Tokunaga (2007), Barrera *et al.* (2005), Erbaugh *et al.*(2010), Luther *et al.* (2005), Mauceria (2004), Nabirye *et al.* (2003).
Influence of opinion leaders	Abd-Ella *et al.* (1981), Adesina *et al.* (2000), Bonabana-Wabbi (2002), Clearfield *et al.* (1986), Strauss et al. (1991), Truong Thi (2008). Asghari and Hadi ,(2009)Jacob (1982).

ture, rate of participation in educational - extensional activities. Asadpour (2011) found that important factors in the adoption of IPM technologies were risk aversion of paddy farmers, the value of yield per hectare, number of pieces of land, the number of release Trichogramma, use the technology in the neighboring land, level of cultivation, experience in application of technology, age of farmers and participation in extension classes. Age and number of pieces of agricultural land technology had negative correlation with adoption of biological control. Table 1 displays the summary of social factors influencing adoption of IPM technologies.

Purpose and objectives

The purpose of this study was to investigate social factors influencing adoption of integrated pest management (IPM) technologies by paddy farmers. The specific objectives of the study were to:

1- Identify characteristics of the respondents;

2- Identify levels of farmers' participation with local associations;

3- Identify the influence of opinion leaders on adoption level of IPM technologies;

4- Determine the correlation between social factors and the extent of IPM technology adoption by farmers

5- Regression analysis for the extent of IPM technologies adoption by independent variables.

MATERIALS AND METHODS

Population and sample

This study was a descriptive-correlation research, carried out in Sari County. The population of the study consisted of paddy farmers (N= 28170) in five districts of Sari County (Chardangeh, Dodangeh, Markazi, Kelijanrestagh, and Miandorod). By calculation Cochran's formula, a sample of 260 farmers was selected by using proportional random sampling method. This formula is:

$$d = t\frac{s}{\sqrt{n}} \qquad n = \frac{N(t.s)^2}{Nd^2 + (t.s)^2}$$

In this formula, (n) is the number of sample, (N) is the number of population, (s) is standard deviation, and (t) is equal to 2. Table 2 displays the statistical population and sample size of this study.

Instrumentation

A questionnaire divided into five parts was used to collect data from the target group. Part one, asked farmers to specify their demographic information such as age, educational level, and agricultural experience. Part two, was asked farmers' membership in rural- agricultural cooperatives. Part three, assessed farmers' participation in extension-education activities and FFS programs (divided them in two groups: participants and non-participants). Part four, as-

Table 2: Statistical population and sample size of the study

County	District	No. of paddy farmers per district	Sample size
Sari	Chardangeh	3928	36
	Dodangeh	2121	20
	Markazi	12178	112
	Kelijanrestagh	3815	35
	Miandorod	6125	57
	Total	28170	260

Table 3: Adoption level of IPM technologies

Level	Frequency	%
Low	52	20.0
Relatively low	64	24.7
Relatively high	101	38.8
High	43	16.5
Total	260	100.0

Mean= 100.19 SD= 15.16

sessed participation of farmers in local associations, using likert-type scale (0 = none, 1 = very low, 2 = low, 3 = intermediate, 4 = high and 5 = very high). Part five, assessed level of opinion leaders influence on adoption of IPM technologies, using likert-type scale (0 = none, 1 =very low, 2 = low, 3 = intermediate, 4 = high, and 5 = very high).

The extent of IPM practices application by paddy farmers was measured in three parts including application of IPM practices for rice pest control (20 questions), application of IPM practices for rice disease control (10 questions) and application of IPM practices for rice weed control (8 questions) (accordance to studies done by Bonabana-Wabbi, 2002; Asai and Tokunaga, 2007; Truong Thi, 2008). All these parts were measured on a Likert-type scale ranged from 0 to 5 (0=none, 1=low, 2=very low, 3=intermediate, 4=high and 5=very high). To categorize the extent of IPM practices application by paddy farmers, the following formula was applied:

Min<A<Mean-SD: A= Negative attitude

Mean- SD <B<Mean: B = Relatively negative attitude

Mean <C<Mean+ SD: C= Relatively positive attitude

Mean+ SD <D<Max: D = Positive attitude

Validity and reliability

Validity of the instrument was obtained by Agricultural Jihad experts of Sari County and some faculty members at University of Tehran, Department of Agricultural Extension and Education. Reliability of the instrument was measured by calculating Cronbach's Alpha coefficient, a measure of internal consistency. The reliability for various parts was more than 0.7, which showed the acceptable level. Data were collected through face to face interviews with farmers at their farms.

Data analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS). Descriptive and inferential statistics were used to analyze the collected data. Descriptive statistics included frequency, percentage, mean, and standard deviation. Correlation coefficient and multiple regression analysis were used in the inferential analysis section.

RESULT AND DISCUSSION

Characteristics of the sample

According to the findings, respondents were on average 49 years old. About 26.5.0% of respondents were between the age of 41 and 50 years. While, 12.0%, 13.5%, 24.2%, 21.1% and 2.7% of respondents were <31, 31-40, 51-60, 61-70 and >70 respectively. 71.9% of the respondents were literate and 28.1% were illiterate. Respondents' experience in agricultural activities was 29 years on average. Findings showed that more than half of the respondents (61.9%) had lands less than 2 hectares in size for cultivation of rice. While, 25.8%, 10.4% and 1.9% of respondents had lands 2-4, 4-6 and > 6 hectares in size respectively. The average income of paddy farmers was 84.96 million Rials annually.

According to the findings, more than half of the respondents (58.4%) had high and very high access to rice pesticides. While, 37.3 percent and 4.3 percent of those reported that they had intermediate and low and very low access to rice pesticides respectively.

Adoption level of IPM technologies by farmers

The extent of IPM practices application by paddy farmers was measured in three parts including application of IPM practices for rice pest control, application of IPM practices for rice disease control, and application of IPM practices for rice weed control. Table 3 shows the level of IPM technologies adoption by farmers. 38.8 percent of respondents adopted IPM technologies at high levels. (Table 3).

Membership in rural-agricultural cooperatives

The findings (Table 4) showed that a majority of farmers were members of rural- agricultural cooperatives (79.2 %) and only 20.8 percent of

Table 4: Farmers' membership in rural-agricultural cooperatives

Membership in rural-agricultural cooperatives	Frequency	%
Yes	206	79.2
No	54	20.8

farmers were not members of rural-agricultural cooperatives. The findings showed that respondents' membership in rural-agricultural cooperatives was on average 15 years.

Participation in extension-education activities and FFS programs

Table 5 showed respondents' participation in extension-education activities and FFS programs. According to the findings, 42.3 percent and 88.1 percent of farmers had never participated in extension-education activities and FFS programs on IPM technologies, respectively.

Participation in local associations

Table 6 shows farmers' level of participation in local associations. 51.2 percent of farmers had low and relatively low participation in local associations. In contrast, 48.8 percent of farmers had high and relatively high participation in local associations.

Influence of opinion leaders on farmers' adoption of IPM technologies

Table 7 shows farmers' view about the level of opinion leaders' influence on adoption of IPM technologies. As it can be seen, opinion leaders had low and relatively low influence on 42.7 percent of farmers for adoption of IPM technologies. In contrast, opinion leaders had high and relatively high influence on 57.3 percent of farmers for adoption of IPM technologies. Also, the findings revealed that local experts and extension agents had the most influence on farmers' adoption of IPM technologies.

Correlation analysis

Correlation for independent variables and the extent of IPM technologies adoption by respondents are presented in table 8. The results indicated that there was positive and significant correlation between IPM technologies adoption and variables including participation in exten-

Table 5: Farmers' participation in extension-education activities and FFS programs

Variable	Groups	Frequency	%
Participation in extension-education activities	participant	150	57.7
	non participant	110	42.3
Participation in FFS	participant	31	11.9
	non participant	229	88.1

Table 6: Farmers' level of participation in local associations

Level	Frequency	%
Low	41	15.8
relatively low	92	35.4
High	88	33.8
Relatively high	39	15.0
Total	260	100

Table 7: Level of opinion leaders' influence on adoption of IPM technologies

Level	Frequency	%
Low	44	16.9
relatively low	67	25.8
High	124	47.7
Relatively high	25	9.6
Total	260	100.0

Table 8: Results of correlation analysis

Variable	Frequency
Membership in rural- agricultural cooperatives	-0.104
Participation in extension-education activities	0.602**
Participation in FFS programs	0.236**
Participation in local associations	0.496**
Opinion leaders	0.174**

** p< 0.01

Table 9: An overview of stepwise model

Model	R	R Square	Adjusted R Square
1	0.496	.246	0.243
2	0.602	362	0.359
3	0.653	0.427	0.420

Table 10: Regression analysis

Description	B	Beta	t	Sig.
Constant	80.175		32.021	0.000
Participation in extension-education activities	2.633	0.500	9.736	0.000
Participation in local associations	4.114	0.214	4.102	0.000
Opinion leaders	2.534	0.129	2.646	0.009

sion-education activities, participation in FFS programs, participation in local associations and opinion leaders. According to the findings, there was no significant correlation between IPM technologies adoption and membership in rural-agricultural cooperatives.

Regression analysis

In order to explain variation in the extent of IPM technologies adoption by farmers, stepwise regression analysis was applied. The R Square value of 0.427 reveals that 42.7 percent of variation in the extent of IPM technologies adoption could be explained by three variables including participation in extension-education activities, participation in local associations, and opinion leaders.

Considering the results shown in the table 10, regression equation in standard situation will be as follow:

$$Y = \text{constant} + B1X1 + B2X2 + B3X3 \quad (1)$$

Y = Extent of IPM technologies adoption, (X_i) is independent variable that included X1= participation in extension-education activities, X2= participation in local associations and X3= opinion leaders. Also, (B_i) is the coefficient of independent variable.

The findings showed that participation in extension-education activities (Beta= 0.500) could explain the most variation in the extent of IPM technologies adoption by farmers.

CONCLUSION

The findings revealed that 38.8 percent of paddy farmers had high level of IPM technologies adoption. The findings indicated that there was positive and significant correlation between farmers' IPM technologies adoption and participation in local associations. This result is accordant to the results of Clearfield *et al*. (1986), Abd-Ella *et al*. (1981), Strauss *et al*. (1991), Adesina *et al*. (2000), Bonabana-Wabbi (2002) and Truong Thi (2008).

There was positive and significant correlation between IPM technologies adoption by farmers and opinion leaders. This result is accordant to the results of Jacob (1982) and Asghari and Hadi (2009). Opinion leaders for their popularity are one of the best channels for delivering and application of technologies, including IPM. This result shows the importance of identification and training of opinion leaders by extension agents for effective IPM technology adoption.

According to the findings, participation in extension-education activities and FFS programs were important factors in adoption of IPM technologies by farmers. These results are accordant to the results of Ridgley and Brush (1992), Boughton and de Faran (1994), Bonabana-Wabbi (2002), Rejaul and Bakshi (2005), Luther *et al*. (2005), Mariyono (2007), Truong Thi (2008) and Noorhosseini Niyaki *et al*. (2010).

RECOMMENDATION

Results suggest the effective role of strengthening communication with farmers to extension employees (extension contacts) for best adoption IPM technology. Therefore, it is recommended to establish extension workshops to increase farmers' knowledge toward IPM practices.

Regression analysis indicated that about half of variation in the extent of IPM technologies adoption could be explained by participation in extension-education activities, participation in local associations, and influence of opinion leaders. The findings revealed that participation in extension-education activities could explain the most variation in the extent of IPM technologies adoption by farmers. It shows the important role of agricultural extension agents which can affect paddy farmers' perceptions and behaviors to adopt and apply IPM technologies. In this regard, use of extension-participatory methods such as farmer field schools is proper strategy for creating positive attitude of farmers towards IPM technologies. Finally, according to the findings and with regard to the impact of opinion leaders on farmers, local leaders' adoption of new technology is important for other farmers to adopt and apply these technologies. So, it is recommended that identification and training of opinion leaders be considered by extension agents for effective IPM technology adoption.

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