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Regression and Discriminative Analysis of Effect of Farmer Field School (FFS) approach on the adoption of biological control in Sari Township, Iran

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ABSTRACT

The aim of this study was regression and discriminative analysis of effect of Farmer Field School (FFS) approach for the adoption of biological control of rice pests in Sari Township, Iran. The research population consisted of 72 farmers who participated in FFS and 346 farmers who had not participated in FFS, which were selected using randomized sampling method. The methodological approach of this study was descriptive-correlative. Validity of the instrument was established using a panel of experts consisting of senior faculty members in agricultural extension and education department. Furthermore, the agricultural officer of Mazandaran Province validated the questionnaire. Pilot test and reliability analysis was conducted and Cronbach's alpha was 0.82. The results of the multiple regression analysis (stepwise method) revealed that the variables of knowledge of biological control, comparative advantage of innovations of biological control, mechanization level, rice farming experience, social participation, the number of contacts with extension agent, the extent to which farmers used mass media and information sources described a variation of 75.9% of the adoption of biological control by rice farmers who had participated in FFS. Also the results of the multiple regression analysis (stepwise method) revealed that the variable of knowledge of biological control described a variation of 83.1% of the adoption of biological control by rice farmers who had not participated in FFS. The results of discriminative analysis revealed that 95.8% of the responders (rice farmers) were properly classified based on the discriminative functions.

Keywords: farmer field school, adoption, biological control, rice farmers, Sari Township.

INTRODUCTION

Major problems related to the paddies of Mazandaran province are the unsustainable use of pesticides against the Rice Stem Borer, their untimely use, and increasing the frequency and amount of pesticide spraying. Fortunately, in 1995, integrated pest management, with emphasis on biological control, as an innovation gradually expanded in the province. But still a large number of rice farmers refuse to accept biological control. Biological control is a considerate operation made by the human beings. It utilizes one or more living organisms to prevent, decrease and control the creatures that directly or indirectly cause damage to agricultural products. In other words, it uses natural enemies or competitors to control those living creatures and pesticides that cause damage to agricultural products. Since the biologic control has been carried out up to 2004, 70000 hectares of rice land has fallen under biological control, , but due to lack of financial support in the crop year 2006-2007, this figure declined to 44,870 hectares [12].

Farmer Field School is a new achievement in the agricultural preaching enterprise and helps farmers to show their stable and full participation at all levels of innovation and act like an expert on their farm. Unlike the traditional approach of preaching which focuses on the technological packages for the farmers, FFS approach includes participative concepts and introduces the farmer as a partner for agent worker and researcher. It also seeks to improve the potentialities for programming, evaluating and decision-making in them so that their analytical skills, critical thinking and creativity can be expanded for the purposes of making better decisions. [5]; [15]; [2]; [18]; [7]. FFS approach is designed to create capacities in farmers so that they can analyze their productive systems, identify their problems, test solutions and choose the most appropriate operation according to their agricultural system. Consequently their productivity and probability will increase [7].

Tripp et al, 2005; Luther et al, 2005; and Bunyatta et al, 2006 came to these conclusions: there are significant differences between the area under cultivation, pest control knowledge, adoption of integrated pest management technologies and approaches to pest control in farmers who have participated in farmer field schools and those who have not participated in these schools. So that the area under cultivation, pest control knowledge, adoption of integrated pest management technologies and approaches to control pests in farmers who have participated in these schools is more. Also there is no significant difference between performance, income and education level of farmers in farmers who have participated in farmer field schools and those who have not participated in these schools [17]; [8]; [3].

Palis et al, 2006; and Partoazam, 2004 came to these conclusions that 66.7 percent of the farmers were satisfied and said that FFS were good or excellent. Also, according to 52.1 percent of the farmers, the effectiveness of the courses was evaluated as good and excellent. Further, the variables of distance from the center of agricultural services, the amount of relationship with those centers and the type of their cultivation system constitute 58.7 percent of their satisfaction with the FFS courses. The 34 percent of the effectiveness of FFS courses is related to the variables of incentives, the number of participations in the courses and educational background [13-14].

In general, we can say that FFS approach has affected social, human, natural, physical and financial capitols. Using this approach, we can improve capacity-makings among the villagers and provide them with a stable development. This study investigates the effects of Farmer Field School approach on biological control of rice pests.

MATERIALS AND METHODS

This research has utilized an applied and scientific purpose. Survey research has been used for the purpose of this study. The study population included two groups of rice farmers from the city of Sari. The first group includes those farmers who participated in the programs of FFS (87 rice farmers) and the second group includes those rice farmers that did not take part in the programs of FFS but at least participated in a tutorial course which was held in the last three years on biologic control(2106 rice farmers). In this study, random sampling is used. Based on Cochran formula, the number of rice farmers who participated in FFS was 72 and the number of rice farmers who did not take part in the programs of FFS but at least participated in a tutorial course which was held in the last three years on biologic control was 346. To determine validity, several copies of the questionnaire were given to the professors of the department of the agricultural education and also to some of the experts in agricultural organization in Mazandaran province. And, to determine the reliability of the research instrument and get variance for sampling, some preliminary tests have been administered. In this test the questionnaire was given to 30 rice farmers in Ghaemshahr in which climatic, economic, social and cultural conditions resembles the ones in the population. After collecting all data, Cronbach's alpha coefficient was calculated for all variables with a rating scale of 0.82

In order to determine the ecological status of paddy (of crop rotation, use of pesticide, herbicide, and fertilizers, etc.) including 7 questions, an attitude toward biological control including 6 questions, social permeability including four questions, six questions of social participation, the amount of the use of information sources by respondents having12 questions, the impact of training courses - 20 questions relating to goals of the courses, the relative advantages of biological control strategies 4 questions, 4 questions of adaptability of strategies for biological control, testability of biological control strategies including 2 questions, visibility of the strategies of biologic control including 4 questions, and the complicatedness of the strategies of biologic control having 4 questions ,all of which was measured based on six-point Likert scale.

To measure the knowledge of biological control by rice farmers, 16 questions have been asked about biological control and borer worm. Each question contained three or four choices. Out of these choices, one choice was completely correct; one choice fairly correct and other choice were completely incorrect. Two scores were dedicated to completely correct responses, one score to fairly correct responses and no score to wrong responses. According to the scoring, maximum points were 16*2=32 and the minimum points were 16*0=0

In addition, in order to determine the degree of adoption and applicability of biologic control, 8 questions have been asked about the use of new techniques and methods of biologic control. Six open questions and two questions were in the framework of 6-choice Likert. Based on the correct application of the Methods the questions were scored from zero to five. According to the scoring, maximum points were 8*5=40 and the minimum points were 8*0=0.

Table (1): Variables validity of the research

Variable	Cronbach's alpha
ecological conditions	0.83
social permeability	0.79
social participation	0.80
use of information resources	0.81
extension - training activities	0.84
innovation characteristics	0.77
attitude towards the adoption of biological control	0.82
biological control adoption	0.87

RESULTS

Adoption of biological control

Table 1 shows the adoption of biological control in both groups of rice farmers. Based on the table, 9.7 percent of the rice farmers who participated in FFS had low adoption, 26.4 percent had average adoption and 63.9 percent had high and very high adoption. The average adoption of the biologic control of these rice farmers is 25.9 and their standard deviation is 5.7. In addition, 40.2 percent of the rice farmers who did not take part in FFS had low and very low adoption, 46.5% had average adoption and 13.3% had high adoption. Based on t-test, there is a significant difference of 0.01 between the average adoptions of biologic control in both groups of rice farmers. The result was that the average adoption of the biologic control of the rice farmers who participated in FFS was higher.

Table 2- the adoption degree of the biologic control of respondent rice farmers

adoption degree	participated in FFS			Did not participated in FFS		
	Frequency	Frequency %	Cumulative frequency	Frequency	Frequency %	Cumulative frequency
Very low(0-8)	0	0	0	45	13	13
Low(9-16)	7	9.7	9.7	94	27.2	40.2
Average(17-24)	19	26.4	36.1	161	46.5	86.7
High(25-32)	35	48.6	84.7	46	13.3	100
Very high(33-40)	11	15.3	100	0	0	100
Total	72	100	-	346	100	-
	Sd= 5.7 AV= 25.9			Sd= 5.7 AV=25.9		

Table 3 –comparison of the adoption degree of biologic control in two groups of rice farmers (rice farmers who participated in FFS)

independent / dependent	participated in FFS n= 72		Did not participated in FFS n= 346		t	significant
adoption of biologic control	25.9	5.72	17.58	5.73	11.21	0.000

Regression analysis of FFS approach on the adoption of biologic control.

After entering the personal, agronomic, social, communicational, knowledge-based and economic characteristics and innovation of both groups (participating in the school farm, and those who did not participate) the following results were obtained in the regression equation and calculation of the significance of each variable using step-by-step method. The regression equation for those rice farmers who participated in FFS was significant with F =24.81at the level of 0.000 .

It is noteworthy to mention that we have the following percents for the changes of the adoption of biologic control: knowledge of biological control 34.8%, the relative advantage of the strategies for biologic control 14.7%, the level of mechanization 8.3%, a experience of rice cultivation 9.5%, social participation 2.5%, the number of contacts with the agent worker 2%, the use of information resources 1.8 % and the use of mass media 2.3%. The regression equation for those rice farmers who did not participate in FFS was significant with F=1780.4 at the level of 0.000. This regression analysis has got 19 steps and these 19 variables justify 99% of the changes in the adoption of biologic control. it is noteworthy to mention that we have these percent for the followings: the knowledge of biologic control 83.1%, the impact of training activities4.9 percent, the ratio of cost-benefit 2.9%,and information resources 3.2% .Tables 4 and 5 show the impact of each of the variables on the adoption of biologic control in both groups of rice farmers.

Table 4. Stepwise regression for the purposes of justifying the impacts of the characteristics of rice farmers participating in FFS on the adoption of biologic control

Variable	B	Beta	t	Sig.
constant	6.51	-	1.95	0.056
knowledge of biological control(X_1)	0.705	0.514	6.71	0.000
comparative advantage of innovations of biological control(X_2)	0.592	0.330	4.78	0.000
level of mechanization(X_3)	0.167	0.267	3.73	0.000
experience of rice cultivation(X_4)	0.106	0.250	3.16	0.002
social participation(X_5)	0.193	0.177	2.35	0.022
the number of contacts with agent workers(X_6)	0.567	-0.153	-2.01	0.049
using information resources(X_7)	0.234	0.293	3.12	0.003
use of mass media(X_8)	0.138	0.256	2.43	0.018
F= 24.81 *SigF= 0.000*		*R= 0.871*	*R^2= 0.759*	

$$Y=6.51+0.705X_1+0.592X_2+0.167X_3-0.106X_4+0.193X_5+0.567X_6+0.234X_7+0.138X_8$$

Table 5. Stepwise regression for the purposes of justifying the impacts of the characteristics of rice farmers participating in FFS on the adoption of biologic control

Variable	B	Beta	T	Sig.
constant	-13.78	-	-12.95	
knowledge of biological control(X_1)	1.08	0.789	62.69	0.000
the impact of training activities(X_2)	0.05	0.113	6.71	0.000
the ratio of cost-benefit(X_3)	1.25	0.132	13.79	0.000
the use of information resources(X_4)	0.089	0.097	7.08	0.000
the amount of used poisons(X_5)	-0.156	-0.268	-20.75	0.000
the number of the contacts with the agent worker (X_6)	-2.22	-0.329	-25.87	0.000
social permeability (X_7)	0.337	0.152	16.05	0.000
Income (X_8)	5.9	0.159	13.84	0.000
the adaptability of the innovations in the biologic control(X_9)	0.159	0.085	6.72	0.000
ecological conditions(X_{10})	0.181	0.098	10.79	0.000
the experience of rice cultivation(X_{11})	-0.131	-0.232	-13.49	0.000
Age(X_{12})	0.033	0.07	3.31	0.001
the attitude toward biologic control(X_{13})	0.044	0.02	1.82	0.069
educational background(X_{14})	-0.26	-0.179	-8.85	0.000
visibility of the innovations in the biological control(X_{15})	0.232	0.152	6.39	0.000
testability of the innovations in the biological control(X_{16})	0.61	0.148	-6.31	0.000
the comparative advantage of the innovations in the biological control(X_{17})	0.161	0.1	7.29	0.000
social participation(X_{18})	0.148	0.093	5.03	0.000
performance(X_{19})	-0.365	-0.046	-4.12	0.000
F= 1780.42 SigF = 0.000 R=0.995		R^2 = 0.99		

$$Y=-13.78+1.08X_1+0.05X_2+1.25X_3+0.089X_4-0.156X_5-2.22X_6+0.337X_7+5.9X_8+0.159X_9+0.181X_{10}-0.131X_{11}+0.033X_{12}+0.044X_{13}+0.26X_{14}+0.232X_{15}+0.61X_{16}+0.161X_{17}-0.365X_{18}$$

In order to determine the difference between Beta coefficients in the regression equation in two groups of rice farmers, Z statistics has been used. The results indicate that there is a significant difference at the level of 99% between beta coefficients, the variables of age, educational background, agricultural experience, the experience of rice cultivation, the amount of used poison, ecological conditions, income, the attitude toward biologic control, social participation, the use of mass media, the use of information resources, the impact of training activities and the knowledge of biologic control.

Table 6: A comparison of beta coefficients in the regression equation in two groups of rice farmers

Variable	participated in FFS n= 72		Did not participated in FFS n= 346		z
	Beta	Variance	Beta	Variance	
Age	-0.122	0.008	0.227	0.001	3.83
Level of education	0.112	0.026	0.214	0.001	2.00
Experience of agriculture	1.022	0.019	0.153	0.000	8.39
experience of rice cultivation	-0.540	0.006	-0.262	0.000	3.43
Level of rice cultivation	1.409	2.151	-0.008	0.058	0.95
Total of Level cultivation	0.844	0.523	-0.070	0.012	1.06
Number of farm plots	-0.134	0.138	0.012	0.024	0.36
level of mechanization	-0.003	0.006	0.039	0.000	0.55
the amount of used poisons	0.176	0.004	-0.223	0.000	6.43
ecological conditions	-0.256	0.024	0.110	0.001	2.32
the attitude toward biologic control	-0.379	0.041	-0.007	0.002	1.80
social permeability	-0.109	0.023	0.152	0.001	1.68
social participation	0.254	0.013	0.024	0.002	1.87
use of mass media	-0.227	0.004	-0.014	0.000	3.16
the use of information resources	0.188	0.006	0.093	0.000	1.17
the number of the contacts with the agent worker	0.361	0.366	-3.28	0.026	1.10
the impact of training activities	0.074	0.003	0.235	0.000	2.84
knowledge of biological control	0.467	0.014	0.705	0.001	1.96
performance	-0.656	2.416	-0.164	0.047	0.31
Income	-0.474	0.091	0.236	0.011	2.25
the ratio of cost-benefit	0.046	0.515	0.158	0.022	0.34
Comparative advantage	0.056	0.069	0.080	0.001	0.09
Compatibility	0.129	0.075	0.091	0.001	0.14
Testable	-0.156	0.227	-0.054	0.019	0.021
Visibility	0.511	0.073	0.089	.002	1.54
Complexity	0.114	0.078	-0.041	.008	0.25

Discriminative analysis

In this research , 27 variables have been used for analysis which follow as such: age, education, agricultural experience, experience of rice cultivation, the area under rice cultivation, the total crop acreage, number of agronomic land pieces, ecological status, the amount of toxin consumed, level of mechanization, rice yield, income , the cost – benefit ratio, the attitude of rice farmers towards biological control, social permeability, social participation rate, the rate of mass media, the use of information sources, the number of contacts with agent workers, knowledge of biological control, the effect of educational activities, relative advantage, compatibility, testing flexibility, visibility, complexity of FFS approach and the adoption of biological control. According to the F amount, its minimal amount for entering the equation has been 3.84 and the maximum amount for exiting the equation has been 2.71. Sixteen variables have been taken into account in our calculations as follow: agricultural experience, experience of rice cultivation, mechanization level, the cost - benefit, the amount of social participation, use of mass media, the use of information sources, the number of contacts with agent workers, knowledge of biological control, the effect of educational activities, comparative advantage, adaptability, visibility, complicatedness and the degree of adoption in the biologic control. The amounts of Wilk's Lambda, F, and the significant level of each of the variables have been used in our calculations as follows in the table 7.

Table 7: Variables entered in the function

variable	Wilk'Lambda	F	Sig.
Use of mass media	0.519	385.79	0.000
The ratio of cost-benefit	0.385	331.49	0.000
Adaptation strategies for biological control	0.329	281.44	0.000
Complexity strategies for biological control	0.276	216.57	0.000
The number of the contacts with the agent worker	0.258	196.76	0.000
Social participation	0.243	182.18	0.000
level of mechanization	0.234	166.91	0.000
The relative advantages of biological control strategies	0.225	156.01	0.000
The impact of training activities	0.209	154.34	0.000
Visibility strategies of biological control	0.196	151.39	0.000
Age	0.173	160.78	0.000
knowledge of biological control	0.163	159.19	0.000
Adoption of biologic control	0.154	157.96	0.000
Experience of agriculture	0.148	166.26	0.000
Experience of rice cultivation	0.146	157.17	0.000
The use of information resources	0.143	149.73	0.000

A function is written based on the structure of the matrix which is as follows:
$Z=0.394X_1+0.324X_2+0.320X_3+0.066X_4+0.313X_5+0.085X_6+0.114X_7+0.145X_8+0.296X_9+0.301X_{10}-0.005X_{11}+0.105X_{12}+0.225X_{13}+0.005X_{14}+0103X_{15}+0.295X_{16}$

in the function, in order to test the efficiency of the function, we usually use Wilk'Lambda . Since the administration of Wilk'Lambda is very complicated and it s almost like K square, therefore K-square is used to show its significance. As the following table shows, the function is significant at the level of 0.000

Table 8: significant level of function

Variable	Wilk'Lambda	$\chi 2$	Sig.
significant level of function	0.143	792.43	0.000

By entering the quantities of the variables in the function, we come to this conclusion that almost 95.8 of respondents were correctly classified based on the function. The following table shows the classification Results of respondents based on the function

Table 9: Classification of respondents based on the function

prediction based on the function / prediction based on the observation	participated in FFS		Did not participated in FFS		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	69	95.8	3	4.2	72	100
No	0	0	346	100	346	100

The above table shows that 69 people out of 72 participants in FFS and 346 rice farmers who did not participate in FFS were properly classified based on the function

RESULTS AND DISCUSSION

The results showed that there are significant differences at the level of 0.01 between the average adoptions of biological control in both groups of rice farmers so that the average adoption of the biologic control of those rice farmers who participated in FFS is higher. Further, the results of stepwise multi-variable regression show that the variables of the knowledge of biologic control, comparative advantage, mechanization level, the experience of rice cultivation, social participation the number of contacts with the agent workers, the use of information resources and mass media constituted 75.9% of the changes in the adoption of biologic control in the rice farmers who participated in FFS. Meanwhile, the variable of the knowledge of biologic control alone constituted 83.1% of the changes in the adoption of biologic control in the rice farmers who did not take part in FFS. Finally, we reached this conclusion that age, educational background, agricultural experience, the experience of rice cultivation, the amount of toxin consumed, ecological conditions, income, the attitude toward biologic control, social participation, the use of mass

media and information resources, the impact of training activities and the knowledge of biologic control were those variables which were significantly different from each other between two groups of rice farmers. The adoption difference in this two groups (those who participated in FFS and those who did not participate in FFS programs) has been confirmed by Ooi and Kenmore (2005), Bunyatta et al, (2006), and Khisa and Heinemann (2005), Witt et al (2006), Anandajayasekeram et al (2007), Erbaugh et al, (2007) . In addition, in the rice farmers who participated in FFS, we are faced with 8 variables and 75.9%. And, in those rice farmers who did not participate in FFS, we see 19 variables and 99% of the changes in the adoption of biologic control. Tohouamo et al (2005) Ooi and Kenmore (2005), Bunyatta et al, (2006), and Khisa and Heinemann (2005), Witt et al (2006), Anandajayasekeram et al (2007), Erbaugh et al, (2007), Tripp et al, (2005), Luther et al (2005), Khan et al (2005), Mancini et al (2006) (2007), palis (2006), Anandajayasekeram et al (2007) and Erbaugh et al, (2007) also implicitly reached these conclusions. Accordingly, we can have the following suggestion:

1- With regard to the difference in the adoption degree of biologic control in both groups of rice farmers, it is suggested that the decision-makers allocate more facilitative tools for the purpose of having this approach and also choose facilitators who appropriately implement this approach.
2- With regard to knowledge of biological control, comparative advantage of biological control strategies , mechanization level, social participation, use of information resources, and mass media, contact and interaction with the agent worker, educational activities in the adoption and application of biologic control, it is suggested that firstly the knowledge of the rice farmers toward biological control be improved, second the strategies of biologic control should have social, cultural and economic justifications, and third , the contacts of the rice farmers with the researchers, agent workers ,and social information centers should be improved .
3- With regard to the difference between the beta coefficients in the regression equation, it is recommended for greater adoption of biological control. First, agro-ecological conditions of the rice farmers (sustainable agriculture) should be improved. Secondly, we should pay greater attention to the younger and educated rice farmers and finally, rice farmers should be able to observe, test and apply the strategies easily.

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