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Research Paper

Effectiveness of Integrated Pest Management by Farmers Field Schools (IPM/FFS) Approach: The case of Greenhouse Producers of Tehran and Alborz Provinces, Iran

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Abstract

This research investigated the effectiveness of IPM/FFS project from economic, technical, social-communicative, environmental and psychological aspects in a descriptive-correlational design based on the survey method. The research population consisted of 70 greenhouse producers that had implemented IPM/FFS project in Tehran and Alborz provinces, Iran. Using Krejcie and Morgan (1970)'s sample size table and stratified random sampling method, 55 greenhouse producers were selected as the research sample. A questionnaire was the main tool for data collection. The validity of the questionnaire was confirmed by a panel of agricultural extension and education experts and its reliability was confirmed by calculating Cronbach's alpha coefficients ($0.77 \leq \alpha \leq 0.86$). The results showed that the IPM/FFS project has affected social-communicative, psychological, environmental, technical and economic factors, respectively. There were positive and significant relationships between effectiveness of the IPM/FFS project and education, the duration of IPM implementation, satisfaction with governmental support and the characteristics of IPM/FFS learning sites whilst the effectiveness of IPM/FFS project was negatively and significantly related to age and greenhouse area under IPM project. According to multiple regression analysis, the variables of IPM/FFS learning sites, education and satisfaction with governmental supports could account for 66 percent of variance of the effectiveness of IPM/FFS project. Finally, as implementation cost of integrated pest management is usually beyond greenhouse producers' financial ability, it is suggested that the government provide greenhouse producers with more economic supports (e.g. granting loan and special facilities and guaranteed purchase of organic products).

Keywords:
Effectiveness; farmers field schools (FFS); greenhouse producer; Integrated Pest Management (IPM); Farmers Field Schools (FFS), greenhouse producer

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INTRODUCTION

Due to increasing rate of population growth in the world and in Iran, and products import, development of agricultural sector is inevitable. Increasing production is undoubtedly an important prerequisite for agricultural sector and rural society development (Ali Mirzaei et al., 2011). Crop production is dependent on several factors such as physiological, biological and humanity factors whose qualitative and quantitative maximization can be achieved by creating a logical balance between abovementioned factors. Green revolution was an enormous biochemical evolution that increased production in the short run but its economic goals disturbed the balance of the factors. During the green revolution, several chemical compounds including fertilizers and pesticides were used excessively not only creating resistance in pests but also endangering food health, agricultural ecosystem and generally the environment (Bartlett, 2005).

Such problems provoked reaction of many active international organizations in the fields of agriculture, health and environment and resulted in new key plans for extension specialists (Povellet & Deborah, 2006). As some scholars believe, non-industrial countries should apply some extension strategies to involve stakeholders that let the beneficiaries be active in designing and implementing the research programs (Asiabaka, 2009).

To fulfill this approach, since late 1980s, Farmer Field School (FFS) has emerged in some regions in south Asia where rice was cultivated as a solution to help FAO focus on Integrated Pest Management (IPM), and several subjects such as product processing, forest management or even social health were included gradually (Eicher, 2007). FFS is a comprehensive research process and a field learning to explore and recognize farmer's agroecology in order to enable and make them skillful production managers with the goal of qualitative and quantitative development of production (Sharifi-Moghadm, 2007). IPM is defined as the selection and application of a complex of methods according to pest lifecycle, disease lifecycle, and environmental and economic issues to minimize the population of pests to a level lower than the economic threshold and includes all plant production actions regarding agroecology conditions, location and type of agricultural utilization and supporting the useful biotic factors (Haddadi, 2004). Application of Integrated Pest Management considering the Farmer Field School (IPM/FFS) has shown that educational and applied collaborative programs can play influential role in promoting farmer knowledge about several aspects of IPM, increase their understanding of agroecology, pest lifecycle and natural enemies of these harmful species, and stimulate local innovation (Bartlett, 2005).

This approach is based on four main principles including healthy crop production, the protection of natural enemies of pests, regular monitoring of farms, and changing farmers into specialists by emphasis on their participation. The approach is based on three main activities: "farm agroecology participation", "analysis of agricultural ecosystem" and "summarizing and result presentation" (Bartlett, 2005).

The success of participatory extension approaches, especially IPM/FFS projects, have led the Ministry of Agriculture to use the FFS method in performing projects and optimizing the use of chemical pests since 2001 and the IPM global facility section of FAO showed its support of this project by sending an international specialist (Soleimani-Omid, 2006). Therefore, regarding the significant results of this approach in empowering farmers (Jurgen, 2007), it was adopted as a comprehensive plan in several provinces of Iran so that now there are 448 IPM/FFS sites active in 32 provinces of which 30 and 13 sites are located in Tehran and Alborz provinces, respectively. This project has been adopted in Tehran and Alborz provinces since 2004 with a focus on agriculture, horticulture, greenhouses, and livestock (Ahmadvand, 2012).

Contradictory results have been reported about the effectiveness of IPM with FFS approach (IPM/FFS), which can be attributed to their methods and hypotheses (Godtland et al., 2004). Some of important relevant studies are reviewed below:

Zuger (2004) showed that FSS improved knowledge of potato farmers, changed varieties used by them, enhanced their performance and decision making, and empowered them. Also, the IPM/FFS-trained potato farmers were more careful about their safety during preparing and using pesticides, but IPM/FFS was less successful in convincing the potato farmers to accept intensive methods of IPM and use less pesticides.

Moumenihelali and Ahmadpour (2012) addressed the factors underpinning adoption of biological control in FFS by rice producers in Babol County, Iran and showed that the independent variables 'rice farmer attitude towards biological control', 'the use of information sources' and 'knowledge of biological control' accounted for 85.5% of the variance of the dependent variable 'adopting biological control' .

Kimani and Mafa (2002) showed that FFS was effective in alleviating the problems caused by pests, increasing crop varieties, improving knowledge, increasing revenue, enhancing soil fertility, and improving practical skills of IPM.

Anandajayasekeram et al. (2007) reported that FFS improved the perception of participants and facilitated their relationship with researchers and extension agents. Also, this approach significantly motivated the adoption of such technologies as IPM.

David (2007) found that FFS built social and communicational skills in farmers such as increasing confidence, forming and leading farmer field school groups, and listening to one another. Van Den Berg (2004) confirmed rapid and developmental effects of IPM / FFS from technical, political and social aspects.

Feder et al. (2004) analyzed the panel data for the 1991-1999 period in Indonesia using the DID technique. Their statistical population included graduated students of field schools and their neighbors who probably acquired information from the graduates through informal communications. The results showed that implementing IPM/FFS did not have a significant impact on the use of pesticides and product performance.

Ali Mirzaei et al. (2011) randomly studied 66 farmers who participated in IPM/FFS courses and 106 farmers trained by a teacher-based conventional method in Abadan city. The findings showed that the farmers who had participated in IPM/FFS courses using participatory learning principles had much more knowledge about palm groves integrated management than the farmers of the other group. Also, the regression analysis revealed that the variable "participation in meetings" was the most vigorous in capturing knowledge of the farmers who had participated in IPM/FFS courses.

Hoseinzadeh et al. (2010) showed that a good majority (83.3%) of farmers who had participated in IPM/FFS were informed of the pesticides threats.

In another study by Etehadi et al. (2011), it was shown that technical knowledge rate, attitude and skills of half of the farmers participating in IPM/FFS were within the range of good to very good. The results of multiple regression analysis showed that the variables with the greatest influence on technical knowledge (36.9%) included age and agricultural backgrounds, the variables with the greatest impact on attitude (30.6%) included technical knowledge and the most important factors influencing farmer's skills (27.6%) included technical knowledge and attitude. Therefore, the more the knowledge and attitude about IPM the farmers acquire, the more skillful they will be.

Ghorbani Piralidehi et al. (2011) found that FFS was effective in improving knowledge, attitude, skill and desires of participant farmers.

Osku et al. (2007) showed that FFS implementation improved rice producers' technical knowledge and improved their attitude toward the importance of biological control and sustainable development.

As the success of each activity requires studying and recognizing its strengths and weaknesses, this research is a comprehensive study on effectiveness of IPM projects using FFS (IPM/FFS) in Tehran and Alborz provinces. To achieve this goal, some specific objectives are considered as below:

1)Studying greenhouse owners' demographic characteristics;

2)Studying greenhouse owners' opinion about the features of IPM/FFS learning sites;

3)Studying the economic effectiveness of IPM/FFS projects;

4)Studying the technical effectiveness of IPM/FFS projects;

5)Studying the socio-communicational effectiveness of IPM/FFS projects;

6)Studying the bio-environmental effectiveness of IPM/FFS projects, and

7)Studying the psychological effectiveness of IPM/FFS projects.

The conceptual framework of the research is shown in Figure 1 based on the reviewed literature. It is noteworthy to mention that IPM/FFS effectiveness includes five dimensions including economic, technical, socio-communicational, bio-environmental, and psychological.

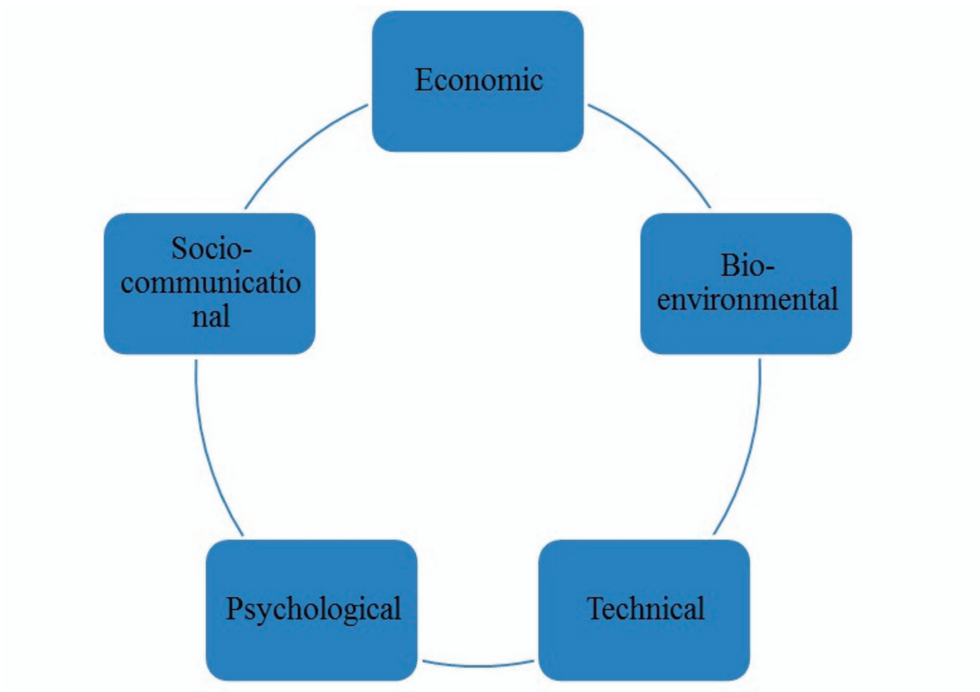

Figure 1. The conceptual framework of the research

METHODOLOGY

The present research is an applied research considering its goal, a survey based on data collection methodology and a descriptive correlational study considering data analysis. The statistical population consisted of the greenhouses in Tehran and Alborz provinces where IPM/FFS projects were performed (N=70). Using Krejcie and Morgan's Sample size table (1991) and stratified random sampling method according to statistical population of greenhouse producers in each province, 55 greenhouse producers were selected as the sample (n=55) (Table 1). The research instrument for data collection was a questionnaire whose validity was verified by a panel of faculty members in agricultural extension and some experts of plant protection in agricultural organizations in Tehran and Alborz provinces. The reliability of the questionnaire was calculated by measuring Cronbach's alpha for each section of the questionnaire (Table 2). The questionnaire consisted of two parts. First part related to personal and professional characteristics and the second part related to independent and IPM/FFS effectiveness dependent variables. The variables of the questionnaire were assessed on a five-point Likert type scale from very low (1) to very high (5). Data were analyzed by SPPS software. The descriptive statistics included central tendency indexes (frequency, percentage, mean, minimum, and maximum) and dispersion indexes (standard deviation and coefficient of variation). In inferential statistics section, the Pearson correlation test and multiple regression were used to test the correlation hypothesis. Meanwhile, intensity of correlation was used in order to exact descriptive of correlation.

Table 1
Population and Sample Size in Different Provinces

Province	Area	N[1]	n[2]	The year of holding learning sites IPM/FFS
	Varamin	14	11	2008-09, 2009-10, 2010-11
Tehran	Pakdasht	12	10	2007-08, 2008-09, 2010-11
	Shahriar	6	4	2004-05
	Savojbolagh	15	12	2008-09, 2010-11
Alborz	Karaj	14	11	2009-10, 2010-11
	Nazarabad	9	7	2008-09
Total		70	55	-

[1] Statistical population
[2] Statistical sample

Table2
Variables and Cronbach's Alpha Coefficient

Parameters	Number of variables	Cronbach's alpha
Economic effectiveness	3	0.77
Technical effectiveness	6	0.78
Socio-communicational effectiveness	11	0.81
Bio-environmental effectiveness	9	0.80
Psychological effectiveness	10	0.86

RESULTS AND DISCUSSION

Personal characteristics of the respondents

Based on findings, the majority of the respondents (81.8%) were male. Most of the respondents (89.1%) were married. The average family size was two. More than half of the respondents (56.4%) had bachelor's degrees. Their average age was about 44 years (Table 3).

Professional characteristics of the respondents

The average work experience of the respondents was 13.75 years. With respect to ownership type of the greenhouses, most of them were owners (54.5%). Considering technological condition of the greenhouses, three-quarters of them (74.5%) were semi-modern. Greenhouse holding was the only job for about 82% of the respondents. The average period of performing IPM was 1.62 years. The greenhouse owners had a mediocre consent rate about governmental support. The average space allocated to IPM projects was 3660 m^2 (Table 4).

Table 3
Personal Characteristics of Greenhouse producers (n=55)

Variable	Variable levels	Frequency	Percentage	Mean	SD	Min	Max
Sex	male	45	81.8	-	-	-	-
	female	10	18.2				
Marital status	single	6	10.9	-	-	-	-
	married	49	89.1				
Family members (person)	1-2	30	54.6	2	1.13	1	4
	3-4	25	45.4				
Education level	Illiterate	0	0	-	-	-	-
	Diploma or lower degrees	16	29.1				
	B.Sc. and B.A.	31	56.4				
	M.Sc. and Ph.D.	8	14.5				
Age (year)	≤40	29	52.8	43.18	9.57	29	64
	41-50	13	23.6				
	≥51	13	23.6				

Table 4
Professional Characteristics of Greenhouse Producers (n = 55)

Variable	Variable levels	Frequency	Percentage	Mean	SD	Min	Max
Work experience in greenhouse (year)	5≤	2	3.6	13.75	5.47	4	25
	5<X≤15	35	63.7				
	<15	18	32.7				
Greenhouse ownership	Personal	30	45.5	-	-	-	-
	Rental	15	27.3				
	Participatory	10	18.2				
Greenhouse modernization	Classic	0	0	-	-	-	-
	Semi-modern	41	74.5				
	Modern	14	25.5				
Having jobs other than greenhouse work	Yes	10	18.2	-	-	-	-
	No	45	81.8				
Period of performing IPM project	1	28	50.9	1.62	0.71	1	3
	2	20	36.4				
	3	7	12.7				
Consent rate about governmental support	Very low and low	16	21.9	2.84	0.63	2	4
	Average	32	58.2				
	High and very high	7	12.7				
Allocated space for performing IPM project (1000 meters square)	3500<	18	32.7	3660	0.66	2	5
	≤3500	37	67.3				

Ranking of the features of IPM/FFS learning sites from greenhouse producers' viewpoint

The features of the IPM/FFS learning sites were evaluated by 11 variables from the greenhouse owners' viewpoint. Based on the findings, "competency of facilitators in making relationship with greenhouse owners", "competency of facilitators in group working" and "suitability of the learning space of the sites" were declared as three superior features of learning sites from the respondents' perspective. But, the abovementioned sites were assessed as weak sites about "competency of the researchers in performing studies relevant to greenhouse owners' needs". The total average of the relevant variables (M=2.96) showed the greenhouse owners' average attitude about the features of the IPM/FFS learning sites (Table 5).

Table 5
Ranking of IPM/FFS Learning Site Features Variables from Greenhouse Owners' Viewpoint (n=55)

Items	Mean*	SD	CV	Rank
Facilitators' competency in making relationship with greenhouse owners	3.13	0.77	0.246	1
Facilitators' competency in performing group work	3.16	0.81	0.256	2
Suitability of the educational space of the sites	3.22	0.85	0.264	3
Researchers having adequate knowledge	3.11	0.83	0.267	4
Adequacy of educational session numbers in one site	3.58	0.96	0.268	5
Facilitators having knowledge needed	2.93	0.79	0.270	6
Suitability of time of doing the project	2.89	0.81	0.280	7
Facilitators competency in managing and organizing the site	3.02	0.85	0.281	8
Accessing to suitable supplementary educational tools	2.49	0.98	0.393	9
Researchers' competency in making relationship with the greenhouse owners	2.53	1	0.395	10
Researchers' competency in performing relevant research meeting greenhouse owners needs	2.51	1	0.398	11
Total	2.96	0.88	0.302	-

*Minimum score =1, Maximum score =5

Economic effectiveness of IPM/FFS project

The economic effectiveness of IPM/FFS project was assessed by three items, whose results are shown in Table 6. The rate of total average of the items (M=2.68) showed that economic effectiveness of the IPM/FFS project was approximately medium. A study by Kimani and Mafa (2002) about the high impact of IPM/FFS projects on farmers' revenue and financial status was not in agreement with the findings of the present research.

Technical effectiveness of IPM/FFS project

The technical impact of the IPM/FFS project was evaluated by six items. Based on the results found in the research, "practical use of IPM knowledge and skills", "recognition of useful and harmful insects from each other" and "defining the economic loss threshold of diseases and weeds" were ranked the first to third, respectively. The abovementioned project has had the least impact on "considering useful local knowledge" and "integrating local and modern knowledge in practice". The total average of the related items (M=3.68) shows that the effectiveness of the abovementioned project is technically almost high (Table 7).

These results are consistent with several studies such as Van Den Berg (2004), Etehadi et al. (2011) and Osku et al. (2007).

Table 6
Ranking the Items of Economic Impact in IPM/FFS Project (n=55)

Items	Mean*	SD	CV	Rank
The cost of buying required inputs	3.36	1.10	0.327	1
Production rate in a definite surface	2.34	1.12	0.479	2
Total revenue	2.33	1.14	0.489	3
Total	2.8	1.12	0.432	-

*Minimum score =1, Maximum score =5

Table 7
Ranking the Technical Impact of the Items in IPM/FFS Project (n=55)

Items	Mean*	SD	CV	Rank
Practical use of IPM knowledge and skills	3.73	0.87	0.233	1
Recognition of useful and harmful insects from each other	3.71	0.87	0.234	2
Defining the economic loss threshold of diseases and weeds	3.72	0.88	0.236	3
Recognition of full life cycle of pests	3.65	0.91	0.249	4
Considering useful local knowledge	3.67	0.92	0.251	5
Integrating local and modern knowledge in practice	3.58	1.13	0.316	6
Total	3.68	0.93	0.254	-

*Minimum score =1, Maximum score =5

Socio-communicational effectiveness of IPM/FFS project

The socio-computational effectiveness of IPM/FFS project was measured against 11 items according to Table 8. Based on the findings, "level of interaction with agricultural facilitators", "teamwork culture", and "social skills (such as management and leadership)" were ranked the first to third, respectively. This project had the least impact on "level of interaction with agricultural researchers". The total average of the items (M=3.66) shows that the effectiveness of IPM/FFS project is almost high considering socio-communication. David (2007) also reported that FFS effectiveness in socio-communicational skills was favorable so that it led to making socio-computational skills in farmers in the form of increased self-confidence, forming and leading to FFS groups and listening to one another.

Bio-environmental effectiveness of IPM/FFS project

Bio-environmental effectiveness of the IPM/FFS project was analyzed against 9 items. The results showed that this project had the strongest impact on "spraying pesticide only at the time of pest resurgence and complying with Pre Harvest Interval (PHI)", "trying to reduce the amount of pesticide residues in crops", and "reducing pesticide spraying times in each agricultural season".

"Self-protection at the time of pesticide spraying (mask, glasses, etc.)" was also ranked the last. Total average of the related items (M=3.41) showed that bio-environmental effectiveness of the IPM/FFS was almost medium (Table 9). In a similar study, Hosseinzadeh et al. (2010) showed that farmers were informed about the threats of pesticides at the IPM/FFS projects and 90.6 percent of them declared it as the most important bio-environmental problem of the pesticides.

Table 8
Ranking of Socio-Communicational Effectiveness Items in ILM/FFS Project (n=55)

Items	Mean*	SD	CV	Rank
Level of interaction with agricultural facilitators	3.87	0.39	0.101	1
Teamwork culture	3.80	0.45	0.118	2
Social skills (management and leadership)	3.93	0.50	0.127	3
Sharing learned skills in IPM/FFS sites with other greenhouse owners	3.74	0.48	0.128	4
Membership rate in social organizations	3.73	0.49	0.131	5
Advising to participate in IPM/FFS sites to other greenhouse owners	3.69	0.51	0.138	6
Social status compared to other greenhouse owners	3.58	0.50	0.140	7
Sharing acquired knowledge in IPM/FFS sites with other greenhouse owners	3.65	0.52	0.142	8
Contribution in solving other greenhouse owners problems	3.34	0.48	0.144	9
Tackling gender discrimination	3.38	0.53	0.157	10
Interaction level with agricultural researchers	3.56	0.71	0.19	11
Total	3.66	0.50	0.139	-

*Minimum score =1, Maximum score =5

Table 9
Ranking the Items of Bio-Environmental Effectiveness of IPM/FFS Project (n = 55)

Items	Mean*	SD	CV	Rank
Pesticide spraying only at the time of pest resurgence complying with PHI	3.54	0.63	0.178	1
Trying to reduce the pesticide residues in crops	3.80	0.73	0.192	2
Reducing the times of pesticide spraying in every agricultural season	3.58	0.76	0.212	3
Reducing intoxication caused by pesticide inhalation	3.64	0.78	0.214	4
Trying to protect natural enemies	3.34	0.75	0.224	5
Improving crop variety	3.78	0.90	0.238	6
Decision making based on eco agriculture analysis	3.51	0.84	0.239	7
Soil fertility improvement	2.71	0.83	0.306	8
Self-protection during pesticide spraying (using masks, glasses, etc.)	2.76	1.03	0.373	9
Total	3.41	0.80	0.242	-

*Minimum score =1, Maximum score =5

Psychological effectiveness of the IPM/FFS project

Based on the findings, this project had the strongest impact on "tolerance of critique", "problem solving skill", "responsibility" and "self-confidence". The mean of all items (M=3.68) showed that the effectiveness of the IPM/FFS project was approximately high (Table 10). David (2007) concluded that FFS fostered skills like self-confidence among farmers.

Table 10
Ranking Psychological Impact Items in IPM/FFS Project

Items	Mean*	SD	CV	Rank
Tolerance of critique	3.84	0.50	0.130	1
Skill in problem solving	3.78	0.50	0.132	2
Responsibility	3.76	0.51	0.136	3
Self-confidence	3.73	0.52	0.139	4
Ability of decision making	3.84	0.54	0.141	5
Risk taking	3.96	0.54	0.146	6
Creativity	3.60	0.56	0.155	7
Making local innovation	3.54	0.57	0.161	8
Independence in managing the greenhouse	3.62	0.59	0.163	9
Continuous learning	3.38	0.56	0.166	10
Total	3.68	0.54	0.147	-

*Minimum score =1, Maximum score =5

Overall impact of IPM/FFS project

The effectiveness of the IPM/FFS project was measured with five economic, technical, socio-communicational, bio-environmental and psychological dimensions. The averages of the five indicators are shown in Table 11. The results showed that the effectiveness of the project is generally at the medium range (M=3.42). Also, the results revealed that the IPM/FFS was effective in "socio-communicative", "psychological", "bio-environmental", "technical" and "economic" aspects (Table 11).

Table 11
Ranking Different Effectiveness Aspects of IPM/FFS Project (n=55)

Variables	Mean*	SD	CV	Rank
Socio-communicative effectiveness	3.66	0.30	0.082	1
Psychological effectiveness	3.68	0.31	0.084	2
Bio-environmental effectiveness	3.41	0.74	0.217	3
Technical effectiveness	3.68	0.86	0.234	4
Economical effectiveness	2.68	0.66	0.246	5
Total	3.42	0.57	0.173	-

*Minimum score =1, Maximum score =5

Correlation between research variables and IPM/FFS effectiveness

The findings of the research showed that there was not a relationship between the number of people dependent to greenhouse owner and their experience with effectiveness of the IPM/FFS project. There was a positive significant statistical relationship between the variables of education, duration of IPM/FFS implementation in greenhouse, satisfaction with the government supports, features of learning sites and the IPM/FFS project effectiveness. There is a negative and significant statistical relationship of age and area allocated to IPM/FFS project in greenhouse with IPM/FFS project effectiveness (Table 12).

Table 12
Correlation between Personal, Professional and Attitudinal Characteristics of Greenhouse Owner Variables and IPM/FFS Effectiveness (n =55)

Variables	**Correlation coefficient**	***P*-value**	**Intensity of correlation*****
Members under custody	- 0.114	0.41	-
Education	0.647**	0.00	Moderate
Age	- 0.575**	0.00	Moderate
Experience in greenhouse holding	0.62	0.65	-
Duration of implementing IPM in greenhouse	0.481**	0.00	Low
Satisfaction of governmental support	0.634	0.00	-
Allocated space to implement the IPM project in greenhouse	- 0.275**	0.00	Negligible
Features of learning sites	0.668**	0.00	Moderate

*$P \le 0.05$; **$P \le 0.001$; ***Very high= 0.90 to 1.00, High= 0.70 to 0.89, Moderate= 0.50 to 0.69, Low=0.30 to 0.49, Negligible= 0.00 to 0.29 (Mukaka, 2012).

Survey on the impact of variables on effectiveness of IPM/FFS project

Step by step regression was used to study the impact of independent variables on dependent ones. Based on adjusted coefficient of determination (R^2_{adj}) of the final model, three variables of IPM/FFs learning sites features, education level and satisfaction with governmental support accounted for about 66 percent of effectiveness changes (Table 13). Based on the findings of the study, the linear equation of regression analysis was as below:

$$Y = 14.633 + 0.174X_1 + 0.277X_2 + 1.171X_3$$

Table 13
Step By Step Regression of the Impact of Independent Variables on IPM/FFS Effectiveness (N=55)

Variables	**B**	**Beta**	**t**	***P*-value**	**R**	**ΔR^2**	**R^2**	**R^2_{adj}**	**F**
IPM/FFS learning sites Features (x_2)	0.174	0.397	4.888	0.000	0.668	-	0.554	0.549	
Education level (x_2)	0.277	0.182	1.717	0.009	0.727	0.105	0.659	0.653	105.162
IPM/FFS learning sites Features (x_2)	1.171	0.144	1.401	0.020	0.734	0.014	0.673	0.665	

CONCLUSION

According to the results of this research, greenhouse owners' evaluation of the features of IPM/FFS learning sites was in an average level. Among several variables, three variables of learning sites, education, and satisfaction with governmental supports captured 66 percent of the variance of the effectiveness variable of IPM/FFS project. According what was said above, we suggest that the authorities support greenhouse owners and improve features and conditions of the sites for having more impacts on IPM/FFS project.

According the results of other sections of this research, the effectiveness of IPM/FFS project in "socio-communication", "psychological", "bio-environmental", "technical" and "economic" aspect was mediocre. Based on the findings of this research, some suggestions can be made as below to improve the effectiveness of the IPM/FFS project:

Since the characteristics of learning sites were identified as one of the important variables in the effectiveness of the IPM/FFS project, it is suggested to provide situations for the exchange of information by creating a communication networks between the learning sites. Holding training courses and classes for familiarizing farmers with the lifecycle of pests and introducing beneficial and harmful insects. In order to improve the social-communication effectiveness of IPM/FFS, it is suggested that before the beginning of learning sites, farmers are encouraged to participate in training courses on the importance of making network, teamwork and information exchange. To increase the bio-environmental effectiveness of the IPM/FFS project, it is suggested that greenhouse owners only spray at the time of pest resurgence considering Pre Harvest Interval (PHI). The results also show that greenhouse owners use no self-protecting tools while spraying. Therefore, it is necessary for them to use protective tools (mask, glasses, etc.) while spraying to reduce intoxication by pest inhalation. To improve the psychological effectiveness of the IPM/FFS project, it is suggested that farmers are encouraged to participate in training courses on strengthening their spirit of risk-taking and application methods of problem solving. To improve the economic effectiveness of the IPM/FFS project, it is suggested to the government to provide lower interest rate loans and guarantee to buy safe products from greenhouse owners. This policy will grant farmers an easy access to equipment and production inputs on the one hand and will improve production and productivity of greenhouse products on the other hand.

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