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Evaluating the effectiveness of integrated pest management with farmer field school (IPM/FFS) approach in Iran

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Abstract

Integrated pest management with farmer field school approach (IPM/FFS) is a participatory extension approach implemented in several years to protect the environment and control pests and plant diseases in the agricultural sector of the country. The main objective of this study was to evaluate extension programs of farmer field school in promoting knowledge, skills and attitude of farmers participating in these programs compared with farmers participating in traditional teacher-centered extension classes. The method of study is survey research and cross-correlation with a comparative approach. The study population consisted of two distinct groups of farmers. The first group of farmers participated FFS extension classes and the second group of farmers participated in the traditional teacher-centered classes. From the first group of study, 97 people and from the second group of study, 98 people were randomly selected. Data were collected through questionnaire and interview with farmers and forming discussion discussions with presence of experts and facilitators of participating in programs of the IPM/FFS. Face validity was confirmed by agricultural specialists, and the reliability of questionnaire was confirmed by Chronbach's Alpha coefficient (79.0 to 91.0). The results of this study showed that the degree of effectiveness of the IPM/FFS's programs was as "good" criteria from the perspective of farmers. In addition, the level of knowledge, skill and attitude of farmers participated in extension programs of the IPM/FFS's programs were more than teacher-centered extension courses, and its differences in the level of one percent error (P=0.01) is significant.

Key words : Agricultural Extension, Attitude, Effectiveness, FFS, IPM, Knowledge, Skill

INTRODUCTION

After World War II, in Europe and America, the use of chemical pesticides increased significantly in order to protect the agricultural fields and orchards from pests and diseases damage. Following it, farmers to cope with the rapid increase in the pest population were forced to use chemical pesticides frequently. The result of repeated use of chemical pesticides against pests and diseases will led to resistance of damaging factors to chemical pesticides and resurgence of pests in many regions. During the 1960s, it became clear that excessive use of pesticides and other chemicals can not only cause resistance of new emerging new generations of pests, but also threat factory environmental sustainability and human health [1]. To prevent the phenomenon of pests and diseases resistance to the effects of chemical pesticides, researchers sought to replace controlling biotic factors with chemical pesticides. In this regard, integrated pest management (IPM) as an ecological strategy was proposed that was based largely on natural control factors such as natural enemies of pests, and it seeks controlling tactics that create the least disturbance in these factors as possible. The success of extension participatory-oriented approaches such as farmer field school (FFS) with the support of FAO since late 1980s in Indonesia and Thailand and other South East Asian countries increased paying attention to participatory approaches in integrated pest management [1]. Integrated pest management approach with farmer field school (IPM/FFS) approach emphasizes on four important principles that including (1) healthy crop production, (2) protection of natural enemies of pests, (3) regular monitoring on fields and (4) conversion of farmers to experts of IPM through getting their active participation consent [2]. In light of Islamic Republic of Iran policies in the field of sustainable agriculture and emphasis on production of healthy products, educational method of FFS/IPM in some levels of provinces of the country (Semnan and Gilan) with the aim of expanding integrated pest management and its change gradually to comprehensive management of protection of product and to promote healthy crop production and sustainability of production resources was placed at the agenda of Ministry of agriculture since 2003-2004 and the first field schools was implemented in the form of model sites on some agriculture products such as rice, legumes spices, potatoes, pistachios and cotton as a pilot. However, in the next years, the number of these sites and variety of products increased [1]. Green Revolution as a great biological and chemical transformation despite helping to increase production in the short term distributed the balance between these factors, because too much emphasis on increased production and economic goals caused that various types of chemical compounds in the form of fertilizers and pesticides to be used [3]. During the 1960s, it became clear that excessive use of pesticides and other chemicals can not only cause resistance in new emerging generations of pests, but also threat environmental sustainability and human health [4]. In this regard, integrated pest management as an ecological strategy was proposed that was based largely on natural control factors such as natural enemies of pests, and it seeks controlling tactics that create the least disturbance in these

factors as possible [5]. Integrated pest management (IPM) is a management system that by taking into account economic, social, production systems, environmental considerations and mobility of populations of pests uses all right techniques in such way that the population level of the pest to be under the economic level [6]. Integrated pest management with approach of farmer field school (IPM/FFS) contributed to compatibility of activities and outcomes of the research, extension and agricultural development systems with the actual conditions of farmers and rural communities by focusing on farmer participation and by institutional coordination and integration of activities, design, implementation and evaluation of programs in farmers conditions and by using local facilities and resources reduce inefficiency in the use of crisis causing resources in systems of extension and research and provide opportunity for these systems to allocate their resources more effectively [7]. In this regard, following welcome of global approach of IPM/FFS, Iranian agricultural extension authorities used this approach in the implementation of integrated pest management (IPM) projects in different regions of the country on several products since 2002. Furthermore, with the development of educational and extension programs of Integrated pest management with approach of FFS not only the knowledge of farmers increased, but also because of the participatory nature of these programs, the skills of farmers on integrated pest management increased and by repeating these programs, attitude of farmers to pest management issues will improve naturally. However, the terms of knowledge, skills and attitudes have scientific definitions that are as follows:

a) Knowledge: Refer to all the theoretical knowledge of the person acquired through formal or informal education. Development of knowledge can be base for development of skills and attitudes but it alone cannot have major influence on the development of individual and managerial competencies.

b) Skill: It is the ability to implement science in practice. Skill is acquired and developed through repetition and application of knowledge. In fact, skill is the physical capacity of the person to perform tasks. Skill development results in improved performance. Ability and skill are similar and the difference between them is that skill is the capacity to do physical work, while ability in addition to physical capacity specifies the capacity for performing intellectual works.

c) Attitude: It is beliefs and mental image of the human of the world and its surroundings. Mental image of human is in fact a framework that explains and forms his domain of thinking and action and leads to correct belief and understanding. Human perception of phenomena surrounding him and his decisions to act are based this mental image and his attitude. The variables of knowledge, skill and attitude are all important aspects of competency discussed in behavioral science and psychology and human resource management [8].

Several studies in the world and Iran examined the effectiveness of the FFS approach that are briefly discussed here.

Mancini *et al*. [9] examined the impact of the FFS approach on social and environmental sustainability of cotton fields in the State of Indian Pradesh Andera. In this study, it is stated that using FFS by cotton farmers in this State caused that their needed information to be transferred easily and chemical consumption to decrease increasingly, while product yield did not reduce. Yang *et al*. [10] also examined the impact of FFS method on integrated management training of pests and small farmers in China. The result of this study shows significant progress in knowledge of pests of vegetables, natural enemies of the pests and ecology of diseases among farmers who participated in farmer field school, while this progress was not seen in the traditional educational methods. Studies conducted by Davis *et al.* [11] in Africa suggest that the courses of IPM/FFS by enhancing the information of farmers not only to increase yield and reduce the use of pesticides, but also it was associated with great movement in the development of sustainable agriculture. Van Doren [12] study also showed that this approach had significant role in increasing the information of Cambodian rice farmers to comprehensive field management so that by using it, product yield of these farmers increased by 50% in short term. Study of Chi *et al.* [13] in Vietnam suggests that accurate observation and practical experience of farmers during the IPM/FFS had no much impact in increasing their information and caused change in attitudes about appropriate use of insecticides. David [14] showed that social skills and communication skills, such as increased self-esteem, leadership of school groups in the field, listening to the words of others and respect for there are obtained following attending farmer filed school classes. Ghorbani *et al*. [4] in a study entitled examining the effectiveness of the farmer field approach among gardeners of Kermanshah showed that the farmer field school leads to improved knowledge, improved attitudes, skills, and wishes of participating gardeners compared to non-participating gardeners. The researchers recommended the development of this approach is other cities of Kermanshah. Ghane *et al.* [15] evaluated the effectiveness of integrated cotton pest management courses from the perspective of farmers in Garmsar County showed that most of studied subjects know these courses useful. The most important introduced effects include removal of chemical pesticides from pest control system and the use of resistant cultivars in planting stage and the effectiveness of biological methods in human health. Furthermore, the results showed that there are significant positive relationship between personal variables such as age, work experience and education level and the variables of knowledge, attitudes and skills. Aghapour and Mousavi [16] showed that FFS projects in Khuzestan province have been able to contribute to the timely transfer of research findings to farmers and lead to increased productivity of inputs in wheat crops. Hassanpour *et al*. [17] concluded in their study that the lack of an effective marketing system and lack of participation and interaction among farmers and greenhouses in the establishment of a union or marketing co-operative has weakened the marketing system, and increased marketing margins, and ultimately caused farmers to be damaged. While participating in FFS programs can create an intellectual ground for empathy and interaction among regional farmers, it has led to the establishment of a marketing cooperative to sell their products at a more affordable price and ultimately to increase farmers' profits. Ali Mirzaee *et al.* [3] conducted a study entitled farmer field school project impact on increasing the palm farmers' information of integrated management issues. The results showed that the mean difference of farmers' information of IPM/FFS and their counterparts who were trained using teacher-centered approach with the possibility of one percentage of error was significant. In other words, the first group farmers with principal using of participatory learning had more information about integrated pest management issues compared with another group. Furthermore, the correlation results showed that experience of palm planting, education, attending in meetings and age of studied group and their information level of IPM issues have significant positive relationship. According to various researchers, the effectiveness

of farmer field school program at areas of knowledge, skills and attitudes has been assessed and evaluated, but they have not been conducted in a coordinated and cohesive form. Education and extension programs of IPM in light of government policies in the field of sustainable agriculture and an emphasis on production of healthy products in different cities of Kohgiluyeh-va-Boyerahmad (KB) province and with the aim of extension of integrated management of pests and its gradual change towards a comprehensive management of protection of product and an attempt to promoting production of healthy products and sustainability of production sources was implemented since 2005-2006 on the products of apple, citrus and corn, which in the next few years, the number of sites and variety of products increased. Since the principle of these programs with the approach of the farmer field school is an exported proposal, it will be faced with the problems and issues. The present study with the aim of filling this information gap seeks to examine the effectiveness of farmer field school approach in the dimensions of knowledge, skill and attitude and to identify the effective factors in this regard. This information can play role in making decision relating to the continuation or cessation programs and adjusting some of these goals. Thus, the main objective of this study was to evaluate extension programs of FFS in promoting knowledge, skills and attitude of farmers participating in the topics of integrated pest management (IPM) compared with farmers participating in traditional teacher-centered extension classes.

MATERIALS AND METHODS

This research is an applied-developmental in terms of objective and comparative descriptive-analytic with comparative approach in terms of method. To collect information and data required, investigations of documents as well as survey of field research such as completion of questionnaires and interviews were used. Data of study was cross-sectional and population of study consisted of two groups: the first group included farmers who participated in farmer field school (FFS) classes, the second group included farmers who were participated in common teacher-centered extension classes. Both groups of classes followed discussions of integrated pest management or IPM. The questions of questionnaire were extracted through study conducted in this area. Therefore, questionnaire is the main tool of this research consisting of closed questions based on written records and conducting a preliminary exploratory research. Some of the variables were developed in the form of a five-point Likert scale (1-very low, 2-low, 3-moderate, 4-high 5-very high). The base of calculations was based on the relative effect of extension programs of FFS/IPM on farmers in making crop and gardening decisions in crop year of 2015-2016.

a) Validity and reliability

Assessing the validity of indices and the items in the questionnaire after several stages was finally revised by specialists and it was confirmed finally using face validity. To determine the reliability of the questionnaire, a pilot study was performed and the reliability of the questionnaire was assessed by Cronbach's alpha test. Thus, a pilot study with 25 questionnaires was used as base to assess the reliability. It should be noted that Pedhazur [18] considered the reliability between 0.5 and 0.8 acceptable for non-experimental research. In this study, obtaining Alpha coefficient between 0.79-0.91 for different scales of the questionnaire indicated the appropriate reliability of questionnaire designed (Table 1).

b) Sampling method

Sampling method is this study is Krejcie and Morgan [19] method. First, a list of all participants in in extension classes of farmer field school plan IPM/FFS was taken from Jihad agricultural organization extension management of province. Accordingly, total number of farmers continuously participated in these classes was 135 people. Based on the Krejcie and Morgan sampling method, 97 people were randomly selected. The number of people participated in teacher-centered classes was 98 people selected randomly. In the next step, according to the characteristics and addresses of these people taken form extension management, the required information was obtained by the questionnaire completion and interview.

c) Statistical analysis

For the analysis of dada in this section, descriptive statistics such as mean, standard deviation, and to describe and categorize the indexes, interval of standard deviation from the mean (ISDM) were used [20, 21]. In the analytical section, independent t-test and Kruskal-Wallis (K-W) test were used. Data processing was performed with use of SPSS software package [22].

RESULTS

a) Effectiveness of extension programs of IPM/FFS

Considering the effectiveness of extension programs of IPM/FFS, 12 questions about extension programs of farmer field school on integrated pest management issues were asked. Questions were developed based on five-point Likert ranging from very low to very high. Items of this index were prioritized using rank mean and coefficients of variation. The coefficient of variation or CV indicates rate of variations per one unit of mean. The response of these items can reflects effectiveness of these programs of these programs in farming operations of farmers. Descriptive analysis of items explaining the extent of effectiveness according to Table 2 showed that the majority of farmers believe the impact and effectiveness of extension programs of farmer field school (FFS) that the most effect was stated in the following cases, respectively in terms of priority:

Table 1: Cronbach's Alpha coefficients for scales of measuring tool

Scales of meaning tool	Number of items	Cronbach's Alpha coefficients
Effectiveness of IPM/FFS Programs	12	0.914
Measuring the knowledge of farmers of IPM issues	10	0.790
Measuring the skill of farmers of IPM issues	11	0.858
Measuring the attitude of farmers of IPM issues	9	0.887

Table 2: Evaluation of extension programs (IPM/FFS) in farming decision of farmers

Items (viewing opinions in IPM)	Rank mean*	SD	CV	Priority
In classes of farmer field school (FFS), the knowledge of extension workers and researchers and experience of farmers are discussed and opportunities for dialogue are created.	4.54	0.791	0.174	1
One good feature of FFS was that farmers could train their experience and knowledge to other farmers in a friendly atmosphere	4.28	1.161	0.271	6
The most important educational tools of FFS classes, visiting, and observing in field or garden gaining experience in the real environment of agriculture.	4.40	1.057	0.240	2
The extension strategy of FFS, school educational content is usually adapted to needs and expectations of farmers.	4.08	1.077	0.264	5
farmers field schools can be a starting point in empowerment of farmers to their technical and economic situation	4.22	1.063	0.252	3
Interaction and participation of members was other distinctive features of extension programs of farmer field school (FFS)	4.32	1.114	0.258	4
After implementing extension programs of FFS in various areas, the consumption of Chemical pesticides and herbicides reduced in fields and gardens	3.68	1.271	0.345	9
Farmer field schools programs (FFS) caused that farmers gain more scientific skills in farm management	3.90	1.538	0.394	12
Farmer field school programs in each area caused increased agriculture products	3.88	1.252	0.323	8
Farmer field programs caused increased revenue and profit of farmers in the area	3.81	1.402	0.368	11
Farmer field programs in each area caused increased production of healthy and organic products by farmers of that area	3.89	1.376	0.354	10
In general, in farmer field programs, skill, knowledge, and creativity of members participating enhanced on farm management	3.97	1.237	0.311	7

*Range of means is between 1 and 5

1. Creating opportunities for dialogue and exchange of view among farmers, extension workers and researchers with coefficient of 0.174

2. Visiting and observing in the field and gaining experience in the real environment of agriculture with coefficient of 0.240

3. The empowerment of farmers to their economic and technical situation with coefficient of 0.252

4. Interaction and participation of group members in these classes with coefficient of 0.258

5. The adaptation of educational content of FFS programs with the needs and expectations of farmers in the area with coefficient of 0.264

Other features such as having a friendly atmosphere, improving skill, knowledge and creativity of the participating members, increasing agricultural production of area, reducing the use of chemical pesticides and herbicides in the fields and gardens, increased production of healthy and organic products by farmers and increased revenue and economic profit of farmers were placed in next priorities of the effectiveness of extension programs of IPM/FFS.

As stated in the study method, to assess the quality of the effectiveness of farmer field school programs on issues related to integrated pest management and grouping them, ISDM method was used. In this section, data were classified into four quality levels (poor, moderate, good and excellent) based on the frequency in each level and finally to assess mean levels of quality, non-parametric Kruskal-Wallis test was used. Results of this assessment are summarized in Table 3. Based on this table, overall effectiveness of IPM/FFS programs form the viewpoint of farmers was at the level of "good". However, effectiveness of this program from the viewpoint of 13% of the subjects on integrated pest management was at "poor" level, 14% at "moderate" level, and 70% in the good level and 2 percent in the "excellent" level. Kruskal-Wallis test results also showed a significant difference at the confidence level of more than 99% (P=0.01) between the mentioned quality levels. Based on these results, we can say that the IPM/FFS approach was a positive step in affecting farmers on integrated pest management in KB province in Iran.

b) Assessment and evaluation of knowledge, skills and attitude of farmers

According to Table 4, the knowledge level of farmers participating in the farmer field school classes with mean of 5.75 was more than teacher-centered group with mean of 5.17 on issues related to the IPM. However, T test results showed that this difference in probability level of (P=0.01) is not significant. In other words, farmers participating in FFS classes compared to their counterparts in the other group have almost the same level of knowledge in IPM. Skill level of farmers participating in the FFS

Table 3: Frequency distribution of the effectiveness of IPM/FFS programs From the viewpoint of farmers based on qualitative assessment of ISDM

Degree of index ISDM	F	Percentage of frequency	(K-W) test
Poor	13	13.4	Chi-Square=62.721 ** df=3 Signif=0.000
Moderate	14	14.4	
Good	69.4	70.1	
Excellent	2	2.1	

* and ** respectively show significant at the probability level of 5 and 1%

Table 4: Results of independent T-test, comparing the means of knowledge, skills and attitudes of two groups of learners on IPM issues

Evaluation index	Group	Mean index	T value	df	p-value
Knowledge	Participants in the FFS school program	5.75	1.69	193	0.093
	Participants in teacher-centered program	5.17			
Skill	Participants in the FFS school program	41.0	4.441	193	0.000
	Participants in teacher-centered program	33.9			
Attitude	Participants in the FFS school program	38.2	6.139	193	0.000
	Participants in teacher-centered program	30.3			

* and ** respectively show significant at the probability level of 5 and 1%

classes with mean of 41 was more than that in teacher-centered group with mean of 33.9. T test results showed that this difference in probability level of (P=0.01) is significant. In other words, farmers participating in FFS classes compared to their counterparts in the other group have almost the higher level of technical skill in integrated pest management (IPM) area.

Attitude level of farmers participating in the FFS classes with mean of 38.2 was more than that in teacher-centered group with mean of 30.3. T test results showed that this difference in probability level of 99% (P=0.01) is significant. In other words, the overall attitude of farmers participating in the FFS classes compared to their counterparts in the other group is higher than that in other group on IPM area. Therefore, IPM/FFS approach could take positive steps to change the beliefs and attitude of farmers on integrated pest management.

DISCUSSION

In general, effectiveness of IPM/FFS programs form the viewpoint of farmers based on ISDM quality evaluation index was at the level of "good". However, effectiveness of this program from the viewpoint of 13% of the subjects on integrated pest management was at "poor" level, 14% at "moderate" level, and 70% in the good level and two percent in the "excellent" level. Kruskal-Wallis test results also showed a significant difference at the confidence level of more than 99% between the mentioned quality levels. Based on these results, we can say that the IPM/FFS approach was a positive step in affecting farmers on integrated pest management in KB province. This finding is consistent with result of Ghorbani *et al.* [4] on gardeners of Kermanshah province and the study conducted by Yung *et al.* [10] among China vegetable farmers. Knowledge level of farmers participating in the farmer field school classes with mean of 5.75 was more than teacher-centered group with mean of 5.17 on issues related to the IPM. However based on T test, the results showed that this difference in probability level of (P=0.01) is not significant. In other words, farmers participating in FFS classes compared to their counterparts in the other group have almost the same level of knowledge in IPM. Skill level of farmers participating in the farmer field school classes with mean of 41 was more than that in teacher-centered group with mean of 33.9. T test showed that this difference in probability level of (P=0.01) is significant. In other words, farmers participating in FFS classes compared to their counterparts in the other group have almost the higher level of technical skill in IPM area. Attitude level of farmers participating in the FFS classes with mean of 38.2 was more than that in teacher-centered group with mean of 30.3. T test results showed that this difference in probability level of 99% (P=0.01) is significant. In other words, the overall attitude of farmers participating in FFS classes compared to their counterparts in the other group is higher than that in other group on integrated pest management (IPM) area. Therefore, IPM/FFS approach could take positive steps to change the beliefs and attitude of farmers on integrated pest management. This result is consistent with findings of study conducted by Ali Mirzaee *et al.* [3] on palm farmers of Khuzestan province and the study conducted by David [14] on participants in FFS classes in Cameron and the study conducted by Erbaugh *et al.* [23] in Uganda country.

CONCLUSION

Education and extension programs of IPM in light of government policies in the field of sustainable agriculture and an emphasis on production of healthy products in different cities of KB province and with the aim of extension of integrated management of pests and its gradual change towards a

comprehensive management of protection of product and an attempt to promoting production of healthy products and sustainability of production sources was implemented since 2005-2006 on the products of apple, citrus and corn. Since the principle of these programs with the approach of the farmer field school is an exported proposal, it will be faced with the problems and issues. Therefore, the main problem of this study is whether the new approach implemented in KB compared to past educational and extension methods is effective in improving knowledge, skill and attitudinal dimensions of farmers or not. In this research, descriptive analysis of items explaining the extent the effectiveness of programs of IPM/FFS showed that the majority of farmers believe in the effectiveness of extension programs of FFS that the most effective factors were respectively (1) the creation of opportunities for dialogue between farmers, extension workers and researchers, (2) visiting and observing the farm or garden and gaining experience in real agriculture environment (3) empowerment of farmers to their technical and economic situation (4) the interaction and participation of team members in these classes (5) and adapting educational content of FFS programs with the needs and expectations of farmers in the region. Features such as having a friendly atmosphere, improving skills, knowledge and creativity of the participating members, increasing agricultural production of the products in the area, reducing the use of chemical pesticides and herbicides in the fields and gardens, increasing the production of healthy and organic products by farmers and increasing revenue and profit of farmers ranked next in terms of effectiveness of the IPM/FFS. In addition, the results showed that the levels of knowledge, skill and attitude of participating farmers in the IPM/FFS's extension programs were higher than those who participated in prevalent extension programs (teacher-centered classes).

SUGGESTIONS

According to the results of this research, the following extension programs of IPM/FFS are recommended:

1. As FFS classes in the integrated pests management in terms of creating the opportunity for dialogue and exchange of view among researchers, extension workers, and farmers and due to observation and gaining experience in real agriculture environment and other useful features from the viewpoint of apple gardeners had very good and excellent effectiveness, it is recommended that this kind of extension programs to be included in agenda of agriculture Jihad authorities for other agricultural products of the province that have great importance such as grapes, nuts, and rice.

2. As farmer field school classes with a participatory learning approach compared to teacher-centered classes have more on the impact on increasing the knowledge and skills, and attitude of farmers on integrated pest management, it is recommended that extension programs of IPM/FFS to be developed in province by private sector such as agricultural consulting services companies and to be replaced by teacher-centered extension and educational approaches.

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