

# Farmers Awareness Concerning Negative Effects of Pesticides on Environment in Jordan

Mansoor Maitah<sup>1</sup>, Khaled Zidan<sup>1</sup>, Rami Hodrob<sup>1</sup> & Karel Malec<sup>1</sup>

<sup>1</sup>Department of Economics, Faculty of Economics and Management, Czech University of Life Sciences Prague, Czech Republic

Correspondence: Mansoor Maitah, Faculty of Economics and Management, Czech University of Life Sciences Prague, Kamycka 129, Prague 6, 16921, Czech Rep. E-mail: Maitah@pef.czu.cz

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## Abstract

The main goal of this study was to determine the levels of knowledge of the farmers on the effect of pesticides on environment in Valleys area, Jordan. This is achieved through realizing some secondary objectives such as identification of the farmers' socioeconomic characteristics and its relation to some of the study variables, their attitude towards the negative effects of pesticides on the environment, their knowledge level about pesticides effect and their sources of information about pesticides use, storage and disposal. The study covered valleys areas, and some 98 farmers were included as stratified random sample. The results revealed that the 5% farmers do not rely on agricultural extension but they seek information from other trustworthy sources. The farmers have a positive attitude towards learning about the negative effects of the pesticides on the environment. The study also showed that the most common method of pesticides application is spraying using axi-sprayers or portable sprayers. Strengthen the agricultural extension and increase its effectiveness, promote trust and communication between those who guiding and farmers. Also strengthen the link between agricultural research centers and guiding centers to identify the appropriate type of pesticide to combat, to achieve the best results with least damage. Farmers should be knowledgeable about the importance of continuous medical checking up of their workers and especially those dealing with the agricultural chemicals.

**Keywords:** sustainable agriculture, awareness, clean environment, efficient extension, handling pesticides

## 1. Introduction

It is no longer that the concept of development is limited to achieve economic and social progress, but the preservation and maintenance of the environment has become an important place in the framework of the development process. The preservation of the environment has become one of the major challenges faced by developing countries when planning for the overall development, and no longer development considerations excuse for ignoring conservation environment and to take effective measures to combat pollution.

Agriculture is one of the most important sectors and has experienced a tremendous and significant development since the Kingdom of Jordan came into being. Realizing the importance of agriculture, the kingdom exempted all agricultural equipment from customs' duties in early 1950 (Ministry of Agriculture, 1998). With the passage of time and the continuation of the agricultural developmental process, interests in importing pesticides also emerged. Agricultural development achieved through these initiatives also developed an interest on the use of sophisticated machinery and technologies to replace old traditional agriculture with the modern high input based agriculture.

The past twenty years, Jordan has witnessed a major development in the agricultural sector that was accompanied by extensive use of various types of pesticides to increase agricultural production to meet the needs of the national market of agricultural products. And became the use of chemical pesticides common in pest control to reduce the economic losses of agricultural crops, as the development strategy with a justifiable focus on increasing production, they lead and in fact on the short and long term to pollution and an imbalance in the balance of natural systems, environmental, leading to the emergence of many problems that threaten human life in the Kingdom of Jordan. Agricultural environmental conditions in the kingdom monitored many of the wrong environmental practices, including excessive use of pesticides where statistics show the average annual increase of the quantities of imported pesticides.

The concepts of environmental conservation and maintenance of the soils also emerged as a big challenge in Jordan. Ministry of Agriculture played its role in preserving the environment and framed rules for the importation and registration of chemical pesticides and fertilizers. These rules are in line with the rules issued by the designated commissioner. Despite the presence of rules and regulations, it has been observed that pesticides are not used in an appropriate manner. Much of the portion of chemical pesticides goes to wastage during their use. However, statistics indicates an average annual increase in the quantity of pesticides imported in total imports to the kingdom (Ministry of Water and Irrigation, 2009). Pesticides are used in various types of pests control; remain a big source of air, water and soil pollution, which may negatively affect human health and the living organisms in the environment.

Valleys region in Jordan is famous for growing a variety of crops and the farmers of area are known for their extensive use of different types of pesticides. Valleys area witnessed a remarkable agricultural development in the past twenty years and is still fortunate to maintain its

production levels. It produces about 50% of the total production of Jordan of wheat, fodder crops and vegetables (Ministry of Agriculture, 2005). However, the introduction and expansion on diversification and intensification of crops cultivated in the area also resulted in the diversity and multiplicity of lesions and diseases that did not exist in this province before. Diversification of crops necessitated the use of different types of pesticides to address this new wave of pests and diseases. The quantities of pesticides used in Jordan in 1999 were about 1347 tons, with a value of 12.6 million JD. The locally produced quantities were about 960 tons of which 576 tons were exported to different countries, especially Iraq (Al-Karablieh and Ibrahim, 1999). An amount of about 12 thousand liter of pesticides was used by the directorate of agriculture in the province of Valleys in the year 2009-2010, and about 50000 kg of pesticides were used over an area of 150000 dunums (1000s meter) (JVA, 2011).

The preliminary survey revealed that many farmers in the area use the multiple types and variety of chemical pesticides to combat pests and diseases affecting crops just on the basis of the information provided to them by the dealers and sellers of agricultural inputs and they may not be aware of the fact that pesticides could cause serious damage to the farmers and the environment. There is a literate deficit on the issues caused by the pesticides, their impact on farmers' health and environment; and their relationship with farmers' awareness level. Keeping in view the academic importance of the subject and to provide basic information on the use of pesticides the present study was undertaken with the objectives:

- 1- To identify the awareness level of the farmers on the use of pesticides and the damages to the environment and its components.
- 2- To estimate the level of knowledge of the farmers on the adoption of preventive measures when dealing with pesticides, storage, and disposal of pesticides.
- 3- To identify the role of agricultural extension in farmers' awareness of the negative effects of pesticides on the environment.

## 2. Material and Methods

Sample included all 2460 farmers residing in the province and served by the Department of Agriculture Services in Valleys area. Due to the large size of research area and community farms are far away from each other, a stratified random sample of 5% of the community has been drawn (Krcic and Morgan, 1970). Some 123 questionnaires were distributed among the farmers. Out of this representative sample selected, 25 questionnaires were turned in with incomplete information. Hence the study sample contained 98 farmers.

### 2.1 The Main Variables of the Study Include

**Level of knowledge of pesticide damage:** The study intended to determine the level of damage caused by the pesticides, respondents were classified into four levels of giving each and every one of them a numeric value ranging from (1-4) where the mean number (1) has no knowledge, (2) limited knowledge. (3) to medium (4) a good knowledge of, and the collection of all knowledge levels of farmers was to find the arithmetic average to represent the degree of knowledge of pesticide damage to the extent where the level of knowledge for each factor ranged between (1-4) and therefore the knowledge is limited if the arithmetic average less than 2, and the average if the arithmetic average of the range is between (2-3), and well, if the arithmetic average of more than 3, then the collection of all degrees of knowledge of each farmer to represent the level of knowledge of the farms damaged pesticides.

**Preventive action by the farmers when dealing with pesticides in the field:** The preventive actions taken by the farmers against the pesticides are measured on a scale from 1 to 4, as the figures or pictures not followed; the

scale indicates like (1) is not used, (2) rarely, (3) sometimes (4) always used. Arithmetic averages to represent the degree of use and preventive actions taken by the farmers while dealing with the pesticides.

### The use of methods of disposal of pesticides

The intended use of agricultural methods of disposal of pesticides, residues and their packaging, are measured on a scale from 1 to 4, as the figures or pictures not followed; the scale indicates like (1) is not used, (2) rarely, (3) sometimes (4) always used.

### The use of pesticides storage methods

It means pesticides storage methods used by farmers, and it were measured that was given to the extent of use of each method numeric value ranging from (1 to 3) as the number (1) Rarely, the number (2) Sometimes, the number (3) always.

### 2.2 Methods of Collecting Data

References were made to many researches and studies published in the scientific publications related to subject of this research. Besides, researchers designed questionnaire for this study. In order to test the degree of reliability underlying the questionnaire results and the consistency of the written questions, these were submitted to a group of university professors at the departments of agriculture. To test the validity of questionnaire, 30 farmers were interviewed. The questionnaire carried the interview questions which were used as a means of collecting personal data, and the type of questions, reasonably helped achieving the objectives of research. Data were subjected to statistical analysis.

**Statistical analysis:** The data were subjected to statistical analysis by using Statistical Package for Social Sciences (SPSS). Tests include: Standard deviation in addition to the frequencies and percentages to display the characteristics of respondents, the simple correlation coefficient between some characteristics of social, educational and economic status of the respondents and their relationship with their knowledge regarding pesticides damage and their effects on the environment.

## 3. Results and Discussions

### 3.1 The Level of Knowledge of Pesticide Damage

The results in table -1 show the knowledge level of the respondents toward pesticides damage. The results clearly indicate to somewhat a high knowledge of farmers on the effects of the use of pesticides, soil pollution, harm fertility and toxicity. They were aware of the fact that pesticides cause pollution, can affect soil fertility and impose toxic effects on the soil, Where the proportion of those who have a good or medium knowledge are 55.4% and 53.9% respectively. Also it turns out the low level of knowledge of more than 2.5 on the scale of knowledge of the effects of pesticide use on air pollution compounds toxic, and the relationship between pesticides and deformed peaks developing plants, and the harm of pesticides on the layer of the atmosphere (ozone), where the percentage of those who have knowledge or limited knowledge of 71.3%, 73.6 %, 78.9%, respectively with average mean less than 2 on a scale level of knowledge.

Table 1. Distribution of respondents according to level of knowledge about pesticide damage s (n = 98)

Level of Knowledge Expression	No Knowledge		Limited Knowledge		Medium Knowledge		Good Knowledge		Mean
	No.	%	No.	%	No.	%	No.	%	
	Effects of the use of pesticide contamination of soil and fertility	20	20.4	21	21.4	30	30.6	27	
The damage of toxic pesticides contamination on the soil	25	25.5	20	20.4	21	21.4	30	30.6	2.5
Pesticide damage to organisms in the soil	24	24.5	32	32.6	20	20.4	22	22.4	2.32
The damage of toxic pesticides on living organisms	18	18.3	38	38.7	25	25.5	17	17.3	2.33
Pesticides linked to the injury of human blindness	27	27.5	35	35.7	26	26.5	10	10.2	2.15
Relationship of pesticides in plant burns	31	31.6	35	35.7	19	19.4	13	13.2	2.09
Relationship between pesticides and the injury of the human paralyzed	23	23.3	46	46.9	12	12.9	17	17.3	2.04
Effects of the use of pesticides on the toxic air Pollution	38	38.7	29	29.5	20	20.4	11	11.2	2.1
Pesticides linked to defect peaks developing plants	45	45.9	24	24.4	16	16.3	13	13.2	1.86
Pesticides damage the layer atmosphere (ozone)	40	40.8	34	34.7	10	10.2	14	14.2	1.85

Source: Own Calculations.

In some areas, pesticides have created the pollution problems and the environmental issues due to their excessive use. The fertility had the highest mean value of 2.54 and similarly the damage of toxic pesticides contamination

on the soil also attained a mean value of 2.5; however, farmers had the lowest level of knowledge on the pesticides damage on atmospheric layer/cover and the growing plants with a mean value of 1.85. Shatanawi et al. (2007) reports that change in one or more of the physical, chemical properties, or all or some of the vital components of the environment would lead to adverse effects to humans, plants and animals.

The respondents were distributed according to the digital value, which reflect their knowledge of pesticides damage in three categories as illustrated in table 2. The first category, includes farmers with limited knowledge with 30.6% and are obtaining a numeric value less than 20, with a minimum of 10. The second includes farmers with medium knowledge with proportion of 60.2% and are obtaining a numerical value ranging between 20 and less than 30. the third category includes farmers with good knowledge with proportion of 9.2% who are recipients of a numeric value above 30 and no max than 39.

Table 2. Distribution of respondents according to the digital value of their knowledge about the damage of pesticides

The Numerical value	No.	%
Less than 20 (limited knowledge)	30	30.6
From 20 to less than 30 (medium knowledge)	59	60.2
30 and more (good knowledge)	9	9.2

Source: Own Calculations.

While dealing with the pesticides, and the precautionary measures adopted by the farmers are presented in table 3. Mandel et al., (1996) conducted a study on 502 farms using pesticides in Minnesota, USA. It was observed that 95% of them realized the importance of wearing protective clothing or wears; 88% knew about exposure to pesticides could cause the potential damage; 56% were wearing protective gloves for chemicals and 22% wore gloves for other farm operations; and 75% of the time during the process of pesticide application.

The data in table 3, represents methods of pesticides application in the field, it shows that the respondents depend largely on continuous adoption of two different methods, automatic central spraying machines and portable trailers, where the percentage of used methods of 80% and 65% with mean of 3.75 and 3.60 respectively, whereas residues of spraying remains in soil; and aerosol (bomb) contaminants had the lowest mean values of 1.08 and 1.29 respectively. The results do not match with Mandel et al., (1996) may be because the literacy and awareness levels among the farmers are high in USA.

Table 3. Precautionary methods used when dealing with pesticides (n=98)

Extent of use Method of use	Not used		Rarely		Sometimes		Always		Mean
	No.	%	No.	%	No.	%	No.	%	
Automatic central	2	2.1	8	8.1	9	9.1	79	80.6	3.75
Spraying machines and portable trailer	4	4.1	14	14.2	16	16.3	64	65.3	3.60
Machine dorsal	26	26.5	14	14.2	26	26.5	32	32.6	2.6
Compressed air guns	36	36.7	16	16.3	23	23.4	23	23.4	2.29
The application of machines almahbat	25	25.6	24	24.5	43	43.8	6	6.1	2.26
Disseminator's almahbat	26	26.5	23	23.4	42	42.8	7	7.1	2.26
Allarat	28	28.9	15	15.3	35	35.7	20	20.4	2.22
Machine high-pressure	33	33.6	21	21.4	35	35.7	9	9.1	2.16
Aerosols generators	34	34.6	21	21.4	39	39.8	4	4.1	2.06
The vog avhat	36	36.7	41	41.8	19	19.4	2	2.1	1.88
Intermittent pressure machine	63	64.1	9	9.1	11	11.2	15	15.2	1.69
Machine with the pressure arm	68	69.3	16	16.3	8	8.1	6	6.1	1.46
Allavhat spray	64	65.3	22	22.4	9	9.2	3	3.1	1.45
Micro-machine sized	65	66.6	23	23.4	8	8.1	2	2.1	1.41
Machine constant pressure	77	78.6	9	9.1	5	5.1	7	7.1	1.37
Syringes remaining soil	77	78.6	7	7.14	6	6.1	8	8.1	1.29
Aerosol bomb	93	94.8	8	8.2	2	2.1	1	1.1	1.08

Source: Own Calculations.

### 3.2 The Practice of Preventive Measures When Dealing with the Pesticide

As shown in table 4, that more than 62% of the respondents rely on the card reading pesticide, adherence to the

period of prohibition, make sure of expiration date and do not use hands for mixing without protection, as it ranked the first four average means of 3.58, 3.48, 3.36 and 3.07, respectively, each on a scale degree of using preventive measures. Farmers emphasis, that pesticides packaging must contain all the information on the use, application method and its toxicity level. Information on application method, the doses, periods of prohibition and all the necessary precautions to be taken before, during and after the use must be printed on the labels. The disclosure on the employment of spraying, examine samples of insects and diseases before using the pesticide and allow farm animals entering the field after spraying directly, has come on the last scales with average mean of 1.82, 1.50, 1.20 respectively on a scale degree of dependence of the preventive measures for the use of pesticides in the field. This requires an attention and observation from guiding people, who works in the region, and make indicative programs for farmers shows them the importance of attention to these procedures and their role is important and vital to the health and safety of clients in the agricultural sector and the environment surrounding them.

Researchers like Alam, (1996); Cornwall et al., (1995), also reported the risk of pesticides on the environment and public health in the developing countries. The illiteracy among farmers and agricultural workers is quite low as indicated by many studies. The agricultural workers in many third world countries are illiterate and cannot read a pesticide instruction labels, lack trainings on the application methods of safe use of pesticides, do not wear any protective clothing, and are ignorant on safe storage and appropriate disposal of residual (Shatanawi et al., 2004).

Table 4. Distribution of respondents according to the usual preventive measures when dealing with pesticides (n = 98)

Extent of use Method of use	Not used		Rarely		Sometimes		Always		Mean
	No.	%	No.	%	No.	%	No.	%	
Read the card DDT	6	6.1	3	3.6	17	17.3	72	73.4	3.58
Adherence to the prohibition	4	4.8	6	6.8	24	24.4	64	65.3	3.48
Confirmation of the date of the authority	6	6.8	12	12.2	17	17.3	63	64.3	3.36
Non-use of the hands without the confusion and prevention	20	20.1	8	8.1	9	9.2	61	62.2	3.07
The expense of the required amount of spray	17	17.3	15	15.3	16	16.3	50	51	2.97
Spray cleaning tools after the completion of spraying process	24	24.4	14	14.2	27	27.5	33	33.6	2.66
Shower with soap and water after the completion of spraying process	25	25.5	17	17.3	29	29.6	27	27.5	2.56
Wear protective clothing during spraying	30	30.6	25	25.5	23	23.4	20	20.1	2.29
Add hoc use of tools for mixing	40	40.8	24	24.4	17	17.3	17	17.3	2.07
Periodic disclosure on the employment of spray	50	51	21	21.4	15	15.9	12	12.6	1.82
Determine the type of insect injury and sickness	75	76.5	7	7.1	3	3.6	12	12.3	1.50
Allow farm animals directly after spraying	85	86.7	6	6.12	1	1.2	6	6.12	1.20

Source: Own Calculations.

The distribution of respondents expressing the extent of their use of preventive measures while dealing with the pesticides has been presented in table -5, the first category includes farmers with few degrees of using of preventive methods and their percentage is 16.32% and who are recipients of a numeric value less than 26, with a minimum of 16. The second includes agricultural users moderately and of their percentage is 63.24% and who are recipients of a numeric value ranging between 26 and less than 39, and the third category includes farmers with the highest using degrees of 21.4% and are obtaining a numeric more than 39 up to 52.

Table 5. Distribution of respondents according to the numerical value expressing the extent of their use of preventive measures when dealing with pesticides

The numerical value	NO.	%
Less than 26 (the use of a few)	16	16.32
From 26 to less than 39 (the use of mid-level)	61	62.2
39 and over (use a lot)	21	21.4

Source: Own Calculations.

### 3.3 The Use of Methods of Disposal of Pesticides

As shown in table 6 more than 51% of respondents used the entire quantity purchased as a way to get rid of pesticide residues comparable to 22% of the respondents used method of burning pesticide containers in the open air as a way to get rid of pesticide containers and only 7% of the respondents reuse these empty containers in their daily transferring of farm agricultural products or water.

Table 6. Distribution of the research sample according to the extent of the use of the methods used in the disposal of pesticides

Extent of use Method of use	Not used		Rarely		Sometimes		Always		Mean
	No.	%	No.	%	No.	%	No.	%	
Use the entire quantities purchased	19	19.3	8	8.1	21	21.4	50	51	2
Open burning	29	29.6	17	17.3	30	30.6	22	22.4	1.4
Buried under the soil	28	28.5	20	20.4	27	27.5	23	23.4	1.37
Re the remaining quantities to purchasing source	34	34.6	15	15.3	31	31.3	18	18.3	1.28
Re-use of containers	41	41.8	26	26.5	24	24.4	7	7.7	.92
Help by the Ministry of Agriculture to get rid of waste	78	79.6	13	13.2	3	3.1	4	4.1	.22
Dilute the pesticide by adding other materials	86	87.7	6	6.1	4	4.1	2	2.1	.16
Burn containers in special ovens	83	83.2	6	6.1	3	3.1	6	6.1	.12
Spraying the dilute pesticide on unused soil surface	90	92.1	4	4.1	3	3.1	1	1.1	.08

Source: Own Calculations.

The distribution of respondents according to the digital value which reflects the extent of their use of disposal methods of pesticides in three categories as illustrated in table 7. The first category includes farmers with few degrees of disposal methods and their percentage is 91.8% who are recipients of a numeric value less than 12.5 with a minimum of 12. The second includes farmers users moderately and their percentage is 7.1% who obtained a numerical value ranging between 12.5 and less than 16.67, and the third category includes farmers with a high degree of using with proportion of 1.2% who are recipients of a numeric value more than 16.67 and up to 17.

Table 7. Distribution of respondents according to the numerical value expressing the extent of use of methods of disposal of pesticides

The numerical value	NO.	%
Less than 12.5 (the use of a few)	90	91.8
From 26 to less than 39 (the use of mid-level)	7	7.1
39 and over (use a lot)	1	1.2

Source: Own Calculations

### 3.4 The Use of Pesticides Storage Methods:

As shown in table 8, more than (81%) of respondents have a place dedicated to pesticides storage and 55% of them were not used storage requirements followed when storing pesticides.

Table 8. Distribution of the research sample according to the extent of use of the methods used for the storage of pesticides

Extent of use Method of use	Rarely		Sometimes		Always.		Mean
	No.	%	No.	%	No.	%	
Designated storage (warehouse of pesticides)	6	6.1	11	11.2	80	81.1	2.76
According to the requirements adopted for storage	54	55	17	17.3	27	27.1	1.73
With agricultural materials	62	63.2	19	19.4	17	17.3	1.50
At home	90	92	3	3.1	5	5.5	1.08
In animal shelters	93	94.8	3	3.1	2	2.1	1.05

Source: Own Calculations.

### 3.5 Correlation between Some of the Social, Economic and Education Characteristics of Respondents and Level of Knowledge Regarding the Damage of Pesticides

The distribution of respondents according to the digital value which reflects the extent of their use of storage methods of pesticides in three categories as illustrated in table 9. The first category includes farmers with few degrees of storage methods and their percentage is 36.7% who are recipients of a numeric value less than 8.33 with a minimum of 6. The second includes farmers users moderately and their percentage is 58.1% who obtained a numerical value ranging between 8.33 and less than 11.67, and the third category includes farmers with a high degree of using with proportion of 5.1% who are recipients of a numeric value more than 11.67 and up to 16.

Table 9. Distribution of respondents according to the numerical value expressing the extent of use of methods of storage of pesticides

The numerical value	NO.	%
Less than 8.33 (the use of a few)	36	36.7
From 8.33 to less than 11.67 (the use of mid-level)	57	58.1
11.67 and over (use a lot)	5	5.1

Source: Own Calculations.

### 3.6 Correlation between Some of the Social, Economic and Educational Characteristics of Respondents and Their Attitudes, Knowledge, Use of, Dealing with Pesticides and Their Information Sources

The results in table 10 shows significant positive relationship among age and total farmed area and farmers attitude towards the use of pesticides at significance level of 0.05 and 0.01 level, Where the Pearson correlation coefficient is 0.129 and 0.198 respectively. Also it turns out a significant positive relationship between the independent variables ( age, total farmed area total annual income and educational levels ) and Cognitive level by Pesticides damaging as dependent variable at significance level of 0.05 and 0.01 level, Where the Pearson correlation coefficient is 0.123, 0.423, 0.168 and 0.140 respectively. Table 10 also shows significant positive relationship among total farmed area, total annual income and The quality of the agricultural holding as independent variables and The Extent of use of the methods adopted for the use of pesticides as dependent variable at significance level of 0.05 and 0.01 level, Where the Pearson correlation coefficient is 0.120, 0.311, and 0.147 respectively.

Table 10. Correlation between some of the characteristics of the research sample and attitudes, knowledge and use of pesticides

Independent Variable	Dependent Variable	Farmers attitude towards the use of pesticides	Cognitive level by Pesticides damaging	The Extent of use of the methods adopted for the use of pesticides
Age		0.129*	0.123*	-.020
Educational level		0.125	0.140**	-.094
The total farmed area		0.198**	0.423**	0.120*
The quality of the agricultural holding		0.041	0.038	0.147**
Total annual income		0.87	0.168**	0.311**

\*. Correlation is significant at the 0.05 level \*\*. Correlation is significant at the 0.01 level.

Source: Own Calculations.

## 4. Conclusions and Recommendations

Based on the previous analysis, we can summarize the most important findings of the study in the following points:

- The weakness role of agricultural extension in the delivery of information on how to deal with pesticides and their application, storage and handling what's left and the dependence of farmers on relatives, friends, neighbors, pesticide card, agricultural companies and dealers selling pesticides.

- There is a positive or at least neutral trend generally with respect to the farmers knowledge and attitude to the negative effects of pesticides on the environment.
- The most common methods used by the respondents when they use pesticides in the field is the axi-sprayers or portable sprayers.

Based on the findings of the study, the following recommendations are made:

- Designing and implementation of outreach programs in safe handling of chemical pesticides, whether during the application, storage or disposal of what's left.
- Interest in agricultural extension and increase its effectiveness, promote trust and communication between those who guiding and farmers.
- Strengthen the link between agricultural research centers and guiding centers to identify the appropriate type of pesticide to combat, to achieve the best results with least damage.
- Regular programs in the media, written and audiovisual are needed for the farmers to make them aware of the dangers of such materials and the safety measures to adopt while dealing with them.
- The need to raise awareness and educational level of workers in the field of application of pesticides and work on the assignment of spraying pesticides to trained labor to have sufficient capacity to deal with these chemicals and to avoid the dangers that may result from misuse.
- Farmers' awareness of the importance of making healthy detect League, especially by users of pesticides.

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