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Assessment of Vegetable Farmers' Awareness of the Risks Associated with Overuse of Agricultural Pesticides in Al-Dhuluiyah District, Salah al-Din Governorate

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Abstract

This study aimed to explore the personal, social, and communication characteristics of vegetable farmers and assess their knowledge regarding the harms of excessive use of agricultural pesticides. Additionally, it sought to rank the importance of different research items and examine variations in knowledge levels based on independent variables. The research was conducted in Dhuluiyah district, targeting all registered cucumber and tomato farmers in the Dhuluiyah and Hardaniyeh Agriculture Divisions, totaling 364 farmers. A proportional random sample of 25% (91 farmers) was selected, with 90 valid questionnaires analyzed after excluding one for inconsistent responses. A pre-test involving 20 farmers was conducted to validate the instrument.Results revealed that respondents' characteristics mostly hovered around average levels. Key sources of information included agricultural office owners, friends and neighbors, and radio and television programs. Overall, farmers' knowledge of pesticide harms was low to moderate, with awareness related to vegetable crop damage ranking third in importance. Statistical analysis showed significant differences in knowledge across personal, social, and communication variables. The study highlights the need to enhance farmers' awareness of pesticide risks through targeted agricultural extension activities. Recommendations include providing extension bulletins and organizing field visits to improve farmers' understanding and promote safer pesticide practices.

Keywords: Pesticide overuse awareness, Vegetable farmers knowledge, Agricultural pesticide risks

I. Introduction

Agriculture is one of the key economic sectors in most developing countries, as a large proportion of natural and human resources are concentrated in the agricultural sector and rural areas [1]. Agricultural development represents a vital dimension of the broader economic and social development framework and serves as an important source of the national economy. Agricultural production holds a primary position among development programs and their goals, being the main pathway to improving and advancing agricultural output to achieve food security, especially amid continuous population growth [2].

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This situation necessitates the provision of agricultural technical inputs to ensure high productivity that can alleviate and limit increasing famine problems, particularly in developing countries. Consequently, the use of fertilizers and pesticides has increased significantly in agricultural soils, making pesticides an indispensable agricultural technology for farmers. These chemicals are used to combat pests and diseases affecting crops, regulate growth, optimize cultivation conditions, and preserve harvested produce, becoming characteristic of modern agriculture.

The importance of agricultural pesticides has emerged as a fundamental element for increasing crop production; however, their expanded use often occurs without adequate awareness of associated environmental risks. Studies show that only about 1% of applied pesticides reach the targeted pests, while the remainder affects other organisms in the environment, disturbing ecological balance [3]. Between 1990 and 2018, global pesticide usage increased steadily, with Asia recording the highest application rates (from 2.2 kg/ha in 1990 to 3.6 kg/ha in 2018), while Africa recorded the lowest (0.4 kg/ha/year) during the same period [4]. This increase has led to extensive contamination of agricultural environments, especially through pesticide pollution [5]. Once released, many pesticides degrade into products that can contaminate food, soil, surface water, and groundwater [6].

Pesticides entering the food chain have been linked to increased cases of infertility, spontaneous abortion, birth defects, and delayed embryonic development [7]. Residue analysis revealed the presence of 76 pesticide compounds in 317 soil samples, with 25% to 58% of samples containing various pesticide residues [8]. The most commonly used pesticides are herbicides and insecticides; glyphosate and isoproturon rank among the predominant herbicides, posing serious risks to mammals, humans, and the environment [9]. Chloropicrin remains a widely used insecticide despite regulatory restrictions [10]. Globally, approximately 60 chemical classes with over 2,000 active ingredients are employed to protect crops from a variety of pests, including insects, fungi, bacteria, weeds, and rodents [11].

Although pesticides contribute significantly to pest control and enhanced agricultural productivity, their misuse raises environmental and health concerns. Ideally, pesticides should target only pests, leaving non-target organisms, including humans, unharmed. However, the overuse and misuse of pesticides have caused substantial harm to humans and other organisms [12]. Pesticides—comprising insecticides, fungicides, herbicides, rodenticides, and soil sterilizers—are used worldwide to safeguard crops, food, and livestock, control diseases, and manage aquatic weeds. Human exposure is common, especially in occupational settings such as agricultural production and pesticide application. While pesticides effectively eliminate agricultural pests, they are toxic to non-target species including birds, fish, wildlife, and humans. Prolonged exposure beyond permissible limits causes toxicity. Most pesticides ultimately enter environmental components such as water bodies, where they bioaccumulate in organisms [13].

Evidence suggests that consuming fruits and vegetables free of pesticide contamination reduces the risk of cancers, hypertension, heart disease, diabetes, stroke, and other diseases [14]. Concerns over neonicotinoid pesticides' harmful effects on birds and pollinators, such as bees, prompted the European Union to ban three neonicotinoid compounds in 2018. Numerous studies, including those by Arce et al. (2017) [15] and Phelps et al. (2020) [16], have confirmed these detrimental effects. Most research in this area, such as Al-Khafaf (2009) [17] and Mahrous (2015) [18], indicates that pollution problems largely stem from farmers' limited knowledge about pesticide harms, reliance on informal information sources, and insufficient governmental guidance. Another study confirms that excessive pesticide use is a primary environmental concern [19].

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Common pesticide misuse includes the use of unregistered or illegal products, sale of prohibited pesticides, and improper handling practices, which adversely affect human health, ecosystems, beneficial microorganisms, wildlife, and aquatic species [20]. Misuse behaviors among farmers include purchasing pesticides before proper pest identification, incorrect determination of quantity and timing of application, and inadequate pest management. Agricultural extension services play a crucial role in mitigating these environmental risks by raising awareness, offering guidance on safe pesticide use, and developing strategies to improve environmental management in cooperation with relevant agencies [21].

Extension agents are responsible for disseminating knowledge about the proper selection and safe use of pesticides, aligning with Ministry of Agriculture policies to keep pace with global advancements. Effective farm management involves timely and appropriate pesticide use, positively impacting production quality, preserving soil fertility and biodiversity, and reducing costs [22].

Based on the above, enhancing farmers' knowledge and experience in pesticide selection and use is essential for safer agricultural productivity, increased income, and improved socioeconomic conditions. Accordingly, this study aims to assess vegetable farmers' knowledge of the harmful effects of excessive pesticide use by addressing the following research questions:

1. What are the personal, social, and communication characteristics of vegetable farmers in Al-Dhuluiyah District, Salah al-Din Governorate?
2. What is the level of knowledge of vegetable farmers regarding the harmful effects of excessive agricultural pesticide use?
3. What is the descending order of items in each research area?
4. What differences exist between the average knowledge levels regarding pesticide harms according to independent variables (age, education, years of pesticide use, marital status, type of holding, and information sources)?

Research Objectives:

1. To identify the personal, social, and communication characteristics of the farmers surveyed.

2. To identify the level of knowledge of vegetable farmers regarding the harmful effects of excessive pesticide use in general.

3. To identify the descending order of the items in each research area.

4. To identify the difference between the averages of respondents' knowledge regarding the harmful effects of excessive pesticide use based on the independent variables studied (age, educational level, number of years of pesticide use, marital status, type of holding, and sources of information related to pesticide harms).

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Importance of the Research:

The significance of this study lies in addressing the pollution of the agricultural environment caused by the excessive use of agricultural pesticides. It aims to provide a reliable database for officials, decision-makers, and agricultural extension workers to support informed decision-making. This will help in equipping farmers with the necessary information, knowledge, and skills to rationalize pesticide use, adopt safer pesticide application methods, and ultimately reduce environmental pollution

Research Hypotheses:
A hypothesis is an organized and purposeful statement or conclusion derived from specific information and practical experience, formulated by the researcher to explain observed facts and phenomena, and to guide the research process [23].

1. **Null Hypothesis (H_0):** There is no significant difference between the means of the respondents' knowledge.
2. **Alternative Hypothesis (H_1):** There is a significant difference between at least two means.

Operational Definitions:

1. **Knowledge:** The extent of information that vegetable growers have regarding the excessive use of agricultural pesticides.
2. **Vegetable Grower:** Any farmer or cultivator who grows vegetables within the research area.
3. **Pesticides:** Chemical substances used to affect the reproduction or prevent the spread of agricultural pests, including insects, diseases, weeds, or to eliminate them.
4. **Excessive:** The repeated, high, and irrational use of agricultural pesticides beyond recommended levels.

Research Methodology:

The research methodology is of particular importance to any research, as it enables scientific and objective results that are most closely related to the research topic [24], as "the methodology is a set of general rules and regulations established to arrive at acceptable facts about the issue under study [25]. The researcher adopted the descriptive approach because it is the most appropriate method to achieve the objectives of his research entitled (Farmers' Knowledge of the Harmful Effects of Excessive Use of Agricultural Pesticides in Al-Dhuluiyah District/Salah al-Din Governorate).

Research Area:
Al-Dhuluiyah District, Salah al-Din Governorate, was selected as the research area due to its large population of vegetable farmers, particularly those cultivating tomatoes and cucumbers, which are widely consumed fresh or as

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part of various dishes. Additionally, other crops such as watermelons and melons are also grown in the area. Al-Dhuluiyah is recognized as one of the prominent agricultural regions for vegetable production in Salah al-Din Governorate.

Research Community and Sample:
The research community consisted of all vegetable farmers (tomato and cucumber growers) registered with the Agriculture Division in Al-Dhuluiyah District, including both the Al-Dhuluiyah and Al-Hardaniyah Agriculture Divisions. The total number of farmers was 364, distributed as follows: 220 farmers in the Al-Dhuluiyah Agriculture Division and 144 in the Al-Hardaniyah Agriculture Division. A proportional random sample representing 25% of the total farmers from each division was selected, resulting in 91 respondents. Data from 90 completed questionnaires were analyzed after excluding one questionnaire due to lack of objectivity, as detailed in Table (1).

Table (1) Distribution of the research community and its research sample

T	Agricultural Division	Research community	Research sample
1	Al-Dhuluiya	220	55
2	Hardaniyya	144	36
Total		**364**	**91**

Preparing the Data Collection Tool:
The questionnaire was initially developed by the researchers based on a thorough review of relevant scientific literature and previous studies, as well as consultations with subject-matter experts. The items were designed to align closely with the research objectives and the central research problem, ensuring that the data collected would effectively serve the study's aims. The questionnaire comprised two main sections:

Part One:
This section included questions aimed at capturing the personal, social, and communication characteristics of the respondents. These characteristics included: age, educational level, number of years of pesticide use, and sources of information regarding pesticide-related harms.

Part Two:
This part consisted of a test containing 24 items covering three main dimensions related to the harms caused by excessive use of agricultural pesticides.

Validity:
Two types of validity were established. *Face validity* was confirmed by presenting the questionnaire and its items to a panel of experts for evaluation. *Content validity*, referring to how comprehensively the items represent the construct being measured, was also established through expert judgment. These procedures ensured that the instrument was valid and appropriate for the research purpose [26].

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Pre-test:
A pilot study was conducted on a sample of 20 respondents—12 from the Al-Dhuluiyah Agriculture Division and 8 from the Al-Hardaniyah Division. The objectives of the pre-test included: assessing the clarity of the items, determining respondents' understanding, estimating the time required to complete the questionnaire, and evaluating the reliability and validity of the instrument. Based on the pilot results, certain items were revised to enhance clarity and comprehension. The finalized questionnaire was then deemed suitable for full-scale data collection.

Test Reliability:
Reliability, defined as the consistency of the measurement tool when applied repeatedly under similar conditions, was assessed using Cronbach's alpha. The reliability coefficient reached 0.82, indicating a high level of internal consistency. Additionally, the square root of the reliability coefficient was used to estimate the instrument's validity, yielding a value of 0.88.

Measuring Research Variables

First: Independent Variables

1. **Age:** Measured by the respondent's age in years at the time of data collection. This variable was categorized into three groups using the range rule.
2. **Educational Level:** Categorized into three levels: elementary and below, secondary, and university, and assigned numerical codes (1, 2, and 3), respectively.
3. **Marital Status:** Measured using three categories: single, widowed, and married, with the corresponding numerical codes (1, 2, and 3).
4. **Agricultural Land Ownership:** Assessed through the following options: ownership, contract, and lease, with numerical codes (1, 2, and 3), respectively.
5. **Years of Pesticide Use:** Measured by the number of years the respondent had used pesticides for controlling vegetable crop pests.
6. **Access to Information Sources:** Assessed through ten different sources from which the respondent might obtain relevant information. Responses were measured using the options: "always", "sometimes", "rarely", and "never", coded as (0, 1, 2, and 3), respectively.

Second: Dependent Variable
The level of knowledge among respondents was measured using a 24-item test. Each item had three response options: "I know", "I know somewhat", and "I don't know", assigned the codes (0, 1, and 2), respectively. Thus, the theoretical score range extended from 0 to 48 points.

Methods and Tools of Analysis
The following statistical tools were employed: frequency distribution, percentages, arithmetic mean, standard deviation, weighted mean, relative weight, and the F-test.

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II. Results and Discussion

First Objective: Identifying the personal, social, and communication characteristics of the respondents

Table (2) shows that the largest proportion of respondents (42.2%) belonged to the age group of 36–49 years. Additionally, 30% had attained a secondary level of education. More than half of the respondents were married, and 60% were landholders under contract agreements. Furthermore, over half of the participants had used agricultural pesticides for a period ranging from 9 to 17 years.

Table (2) Distribution of respondents according to personal, social, and communication characteristics and average knowledge

T	Category	Group	Frequency	%	Average	T2	Social Status Category	Frequency	%	Average
1	Age Groups	Young (22-35 years)	29	32.2	14.76	1	Widow	19	21.1	13.10
2		Middle-aged (36-49 years)	38	42.2	12.13	2	Single	22	24.4	12.04
3		Seniors (50 years and older)	23	25.6	11.82	3	Married	49	54.4	12.96
	Total		**90**	**100**	---		**Total**	**90**	**100**	---
4	Educational Level	Elementary and below	35	38.9	11.71	1	Ownership	21	23.3	14.38
5		High school	40	44.4	13.53	2	Contract	54	60.0	12.15
6		University	15	16.7	14.87	3	Lease	25	27.8	13.24
	Total		**90**	**100**	---		**Total**	**90**	**100**	---
7	Years of Pesticide Use	Few (9-17 years)	48	53.3	11.92	1	Information Sources (Few: 6-10)	27	30.0	11.29

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8		Medium (18-26 years)	24	26.7	13.58	2	Information Sources (Medium: 11-15)	28	31.1	12.93
9		Many (27 years and above)	18	20.0	14.83	3	Information Sources (Many: 16 or more)	35	38.9	14.84
	Total		**90**	**100**	---		**Total**	**90**	**100**	---

2- Identifying the Most Important Sources of Information Accessed by Respondents Regarding the Harmful Effects of Agricultural Pesticides

Table (3) shows that the top three sources of information accessed by the surveyed farmers to learn about the harmful effects of excessive pesticide use are: owners of agricultural offices in the markets, friends and neighbors who are experienced farmers, and personal experience, with relative weights of 79.26, 76.30, and 72.59, respectively. The sources ranking lowest, occupying the last three positions, are agricultural companies, radio and television programs, and internet/social networks and advisory meetings and seminars, with relative weights of 35.19, 47.41, and 52.59, respectively. The remaining sources fall in the middle ranks, from fourth to seventh place, with relative weights ranging between 62.59 and 71.85, as detailed in Table (3).

Table (3): Distribution of respondents according to the degree of knowledge of information sources related to the harms of agricultural pesticides.

T	Information Sources	Always	Sometimes	Rarely	Never Consult	Relative Weight	Arrangement
1	Agricultural guides in the agricultural division	34	27	20	9	65.19	6
2	Head of the Prevention Department in the Agricultural Division	35	32	18	5	69.26	5
3	Publications and brochures	28	30	25	7	62.59	7
4	Agricultural office owners in the markets	50	24	16	0	79.26	1
5	Friends and neighbors of distinguished farmers	42	35	10	3	76.30	2
6	Radio and television programs	32	45	8	5	71.85	4

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7	Internet channels and social networks	16	24	32	18	47.41	9
8	Guidance meetings and seminars	24	25	20	21	52.59	8
9	Agricultural companies	9	12	44	25	35.19	10
10	Personal experience	36	39	10	5	72.59	3

3- The Second Objective: To Identify the Level of Knowledge of Vegetable Farmers Regarding the Harmful Effects of Excessive Pesticide Use on Agricultural Crops

The results indicated that the respondents' knowledge scores ranged from a minimum of 8 to a maximum of 20, with a mean of 12.84 and a standard deviation of 3.17. Using the range as a statistical criterion, the respondents were classified into three knowledge level categories. The largest proportion of respondents fell within the intermediate knowledge category, as shown in Table (2).

Table (2) Number and percentage of respondents by general knowledge category. (-3412) 22.62

T	Knowledge Categories	Repetition	%	Average
1	Low (8–11 degrees)	37	41.1%	9.84
2	Medium (12–15 degrees)	30	33.3%	13.23
3	High (16–20 degrees)	23	25.6%	17.17
T	**Total**	**90**	**100%**	**Sd = 3.17**

It is evident from Table (2) that the highest percentage of respondents (41.1%) fell within the low knowledge category, followed by 33.3% in the medium knowledge category. Therefore, the overall level of knowledge among respondents can be described as low, tending toward average. This may be attributed to the respondents' limited awareness. This finding highlights the urgent need to provide respondents with more information and knowledge about the harmful effects of excessive pesticide use and its impact on the environment and its components—including humans, soil, plants, and other terrestrial and aquatic organisms. To address this, targeted awareness-raising activities such as field visits, practical training, and the distribution of brochures and guidance materials related to pesticide damage should be implemented.

Third Objective: Ranking of Research Areas in Descending Order

First Area: Harmful Effects of Agricultural Pesticides on Vegetable Crops

The respondents' answers revealed that the highest relative weight in this area was 56.67%, the lowest was 44.44%, and the overall relative weight averaged 48.88%, as shown in Table (3).

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Table (3) Distribution of farmers surveyed according to their knowledge of the harm caused by excessive use of agricultural pesticides on vegetable crops.

T	Paragraphs of Damage to Vegetable Crops	I Know	%	I Don't Know	%	Relative Weight	Arrangement
1	Repeated spraying of pesticides leads to deterioration of the plant's condition	48	53.3%	42	46.7%	53.33	2
2	Increasing the concentration of the pesticide leads to flower drop	51	56.7%	39	43.3%	56.67	1
3	Repeated and concentrated spraying will burn the plant leaves	45	50.0%	45	50.0%	50.00	3
4	Repeated spraying leads to an increase in the concentration of the pesticide in the plant	44	48.9%	46	51.1%	48.89	4
5	The pesticide kills biological enemies	36	40.0%	54	60.0%	40.00	6
6	The leaves become stunted and dwarfed when the pesticide is repeatedly sprayed	40	44.4%	50	55.6%	44.44	5
T	**General Average**	44	48.8%	46	51.1%	**48.88**	**Third**

It is clear from Table (3) that this field ranked third overall, with 48.8% of respondents aware of the damage caused by the excessive use of pesticides on plants. This percentage is lower than the 51.1% of farmers who are unaware of such damage. This gap may be attributed to the respondents' limited knowledge about pesticide harm to plants or their lack of exposure to targeted extension activities. Additionally, 38.8% of the respondents have a low educational level, which further highlights the need for extension agencies to implement educational programs specifically aimed at vegetable crop farmers to raise their awareness of the adverse effects of excessive pesticide use. The statement "Increasing the concentration of the pesticide leads to flower drop" ranked first with a relative weight of 56.67%. This result may be because farmers directly observe flower drop in the field, thus their experience and awareness increase with repeated pesticide application. Conversely, the statement "The pesticide leads to the killing of biological enemies" ranked last with a relative weight of 40%. This low awareness may be due to a general lack of knowledge about the

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benefits of natural enemies. Therefore, it is crucial to implement educational activities that familiarize farmers with beneficial insects that act as natural enemies by feeding on harmful insect eggs or larvae.

The second area: Harm caused by pesticides to humans.

The respondents' answers indicated that the highest relative weight was 64.44%, the lowest was 44.44%, and the overall relative weight was 53.22% regarding the harmful effects of pesticides on humans, as shown in Table (4).

Table (4) Distribution of farmers surveyed according to their knowledge of the harm caused by excessive use of pesticides to humans.

T	Paragraphs of Harm to Humans	I Know	%	I Don't Know	%	Relative Weight	Arrangement
1	Some pesticides are considered carcinogenic	50	55.6%	40	44.4%	55.56	4
2	Some pesticides cause kidney failure	45	50.0%	45	50.0%	50.00	7
3	Pesticides cause chest allergies and asthma	58	64.4%	32	35.6%	64.44	1
4	Causes disturbance in the nerves of the extremities	54	60.0%	36	40.0%	60.00	2
5	Affecting male fertility and causing infertility	42	46.8%	48	53.3%	46.67	9
6	Pesticides cause atherosclerosis	47	52.2%	43	47.8%	52.22	6
7	Lymphadenitis	44	48.9%	46	51.1%	48.89	8
8	Accumulation of pesticides in the human liver causes damage	51	56.7%	39	43.3%	56.67	3
9	Feeling insomnia and nervous tension	48	53.3%	42	46.7%	53.33	5
10	Highly toxic pesticides cause memory loss	40	44.4%	50	55.6%	44.44	10
T	**General Average**	48	53.2%	42	46.8%	**53.22**	**Second**

It is clear from Table (4) that this field ranked second, with 53.2% of respondents aware of the damage caused by excessive pesticide use to humans, while 46.8% were unaware. This reflects the generally weak knowledge of the

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respondents regarding pesticide-related harm. This situation calls for the Agricultural Extension Authority to enhance guidance efforts and awareness activities targeting vegetable crop farmers, educating them about the health risks and dangers pesticides pose to human life. The item **"**Pesticides cause chest allergies and asthma**"** ranked first, with a relative weight of 64.44%. This may be because allergic reactions, breathing difficulties, and facial redness are immediate and common effects experienced by those exposed to pesticides, which increases farmers' familiarity with these symptoms. In contrast, the item **"**Highly toxic pesticides cause memory loss**"** ranked last, with a relative weight of 44.44%. This lower awareness may be due to the relative rarity or delayed onset of such neurological effects, leading to less recognition or confidence among respondents that pesticides can cause memory loss.

Third Domain: Harmful Effects of Pesticides on Soil and Water

The respondents' answers indicated that the relative weight of knowledge about pesticide damage to soil and water was 54.44%, while the relative weight of lack of knowledge was 45.56%, with an overall relative weight of 54.44%, as shown in Table (5).

Table (5) Descending order of the items in the field of pesticide harm to soil and water according to the respondents' responses.

T	The Effects of Pesticides on Soil and Water	I Know	%	I Don't Know	%	Relative Weight	Arrangement
1	Causing agricultural soil pollution	55	61.11%	35	38.89%	61.11	1
2	Deterioration of agricultural soil fertility	40	44.44%	50	55.56%	44.44	8
3	The pesticide affects beneficial bacteria in the soil	41	45.56%	49	54.44%	45.56	7
4	Death of biological organisms in the soil	54	60.00%	36	40.00%	60.00	2
5	Repeated application of pesticides increases soil contamination with pesticides	50	55.56%	40	44.44%	55.56	5
6	Pesticide leakage leads to groundwater contamination	48	58.89%	42	46.67%	58.89	3
7	Killed a lot of aquatic life	53	56.67%	37	41.33%	56.67	4
8	Pesticide leakage increases its accumulation in the fish's body	51	54.44%	39	43.33%	54.44	6
T	**General Average**	49	54.44%	41	45.56%	**54.44**	**First**

It is clear from Table (5) that this domain ranked first, with 54.44% of the respondents aware of the damage caused by the excessive use of pesticides on soil and water, compared to 45.56% who were unaware. This indicates a generally

University of Thi-Qar Journal of agricultural research

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weak level of knowledge among respondents regarding the harmful effects of pesticides on soil and water. Therefore, it is necessary for the extension agency to implement targeted guidance efforts and educational activities for vegetable crop farmers to raise their awareness about the damage caused by pesticide overuse in these environmental components. The statement **"Causes pollution of agricultural soil"** ranked first with a relative weight of 61.11%. This may be because the respondents clearly understand that pesticides contaminate the area where they are applied, and if they leak into water sources, they cause water pollution. In contrast, the statement **"Deterioration of agricultural soil fertility"** ranked last, with a relative weight of 44.44%. This could be due to respondents' disbelief or lack of awareness that pesticides affect soil fertility. Soil degradation caused by pesticide contamination is not directly visible to farmers and may be unfamiliar to them due to limited scientific knowledge or lack of exposure to extension programs.

Fourth Objective: To identify the significance of differences in respondents' knowledge based on their personal, social, and communication characteristics.

To test the differences between the mean knowledge scores among respondent groups, an F-test was conducted to verify the null hypothesis. The results of the variance analysis are presented in Table (6).

Table (6) Analysis of variance for the difference between the means of the respondents according to the independent variables.

Independent Variable	Sources of Variance	Sum of Squares	df	Mean Square	F Value	Sig.
Age	Between groups	158.193	2	79.096	9.329	0.000
	Within groups	737.630	87	8.479		
	Total	895.822	89			
Educational level	Between groups	133.378	2	66.689	7.610	0.001
	Within groups	762.444	87	8.764		
	Total	895.822	89			
Marital status	Between groups	32.035	2	16.018	1.613	0.205
	Within groups	863.787	87	9.929		
	Total	895.822	89			
Type of possession	Between groups	45.364	2	22.682	2.315	0.105
	Within groups	850.458	87	9.777		
	Total	895.822	89			
Years of pesticide use	Between groups	94.322	2	47.161	5.119	0.008
	Within groups	801.500	87	9.213		
	Total	895.822	89			

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 2 (2025) PP 210-226

https://iasj.rdd.edu.iq/journals/journal/issue/18682 *https://doi.org/10.54174/utjagr.v13i1.323*

Table (6) shows that there is a significant difference at the 0.01 probability level, with a P-value of 0.000, between the mean responses of the respondents according to the age variable. Therefore, the null hypothesis is rejected and the alternative hypothesis is accepted, which states that there is at least one significant difference between two means. Similarly, a significant difference was found between the means according to the educational level at the 0.01 level (P-value = 0.001). There was also a significant difference according to the number of years of pesticide use at the 0.01 level (P-value = 0.008). This statistically indicates the importance of these variables in influencing the respondents' knowledge about the harms of excessive use of agricultural pesticides. On the other hand, the differences in mean responses were not significant for the variables of social status and type of agricultural land ownership. This implies that these two variables do not have a significant impact on the respondents' knowledge about the harms of excessive pesticide use.

Conclusions and Recommendations:

First: Conclusions

1. The descriptive analysis of the variables showed that 42.2% of respondents were in the middle-aged group (36-49 years), 44.4% had a secondary education level, and 53.3% had used pesticides for a low number of years (9-17 years). Additionally, 54% of the respondents were married, 60% owned land through contracts, and 38.9% accessed many sources of information. These percentages generally cluster around average values, suggesting a possible impact on respondents' knowledge levels regarding pesticide harms.
2. The results indicated that the main sources of information for respondents were agricultural office owners, friends and neighbors, and radio/television programs. This suggests a reliance on informal or less specialized sources rather than scientific or expert guidance, which could affect their knowledge about pesticide harms.
3. The general level of knowledge about the harms of agricultural pesticides among respondents was low to moderate, indicating a clear need to provide farmers in the study area with more accurate information and expertise on pesticide risks.
4. Among the knowledge domains, soil and water damage ranked first, human health damage second, and vegetable crop damage third. This ranking highlights the importance of tailoring educational efforts according to the levels of knowledge in each domain, focusing particularly on improving awareness in the domains with lower rankings.
5. The significant differences found between knowledge levels and personal, social, and communication variables highlight the importance of these factors in shaping farmers' understanding of pesticide risks.

Second: Recommendations

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 2 (2025) PP 210-226

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The agricultural extension agency should provide comprehensive information to increase farmers' awareness about the harmful effects of excessive pesticide use and emphasize the importance of rational and safe pesticide application to protect the environment and its components.

It is crucial to use guidance methods and approaches suited to the farmers' educational levels, focusing on safe pesticide use and preventing overuse and its associated harms. Farmers in the study area should be encouraged to apply scientific recommendations.

Extension programs should prioritize the most effective and preferred guidance methods for farmers, such as field visits, practical demonstrations, field programs, and agricultural media, to ensure the successful delivery and uptake of information.

When designing guidance programs, attention should be paid to the independent variables (such as age, education, and years of pesticide use) that showed significant differences in knowledge levels, to better tailor educational efforts to the target groups.

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