An-Najah National University

Faculty of Graduate Studies

Evaluation of the impacts of uncontrolled agricultural practices on soil and water resources on the Al-Far’a catchment

By

Do'a Fayez Abdullah

Supervisor

Prof. Dr. Marwan Haddad

This Thesis is Submitted in Partial Fulfillment of the Requirement for the Degree of Master of Environmental Sciences, Faculty of Graduate Studies, An-Najah National University, Nablus, Palestine.

2014

Evaluation of the impacts of uncontrolled agricultural practices on soil and water resources on the Al-Far'a catchment

By

Do'a Fayez Abdullah

This thesis was defended successfully on 1 / 6 / 2014 and approved by:

Defense Committee members		Signature
– Prof. Dr. Marwan Haddad	(Supervisor)	………………………
– Dr. Abdallah Omari	(External examiner)	………………………
– Dr. Munqez Shtaya	(Internal examiner)	………………………

Dedication

My grateful thanks and appreciation are for my precious parents, for their encouragement, effort, patience and for everything they did for me until I finished this work.

My grateful thanks are also for my sisters, my brothers and all my family.

Acknowledgments

After thanking Allah, who granted me the power to finish this work.

I wish to express profound gratitude to my supervisor Prof. Dr Marwan Haddad for his invaluable support, encouragement, supervision and useful suggestions throughout this research.

My master study was funded through the American Consulate General in East Jerusalem. I am grateful for their support and scholarship fund.

My thanks are also expressed to all faculty members of An-Najah National University especially water and environmental studies institute, and Chemical, Biological and Drug Center for their cooperation.

الإقرار

أنا الموقع/ة أدناه، الرسالة التي تحمل العنوان:

Evaluation of the impacts of uncontrolled agricultural practices on soil and water resources on the Al-Far'a catchment

أُقرُّ بأنَّ ما اشتملت عليه هذه الرسالة، إنّما هي نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وإن هذه الرسالة ككلّها ، أو أي جزء منها لم يقدم من قبل لنيل أية درجة، أو لقب علميّ، أو بحثيّ لدى أية مؤسسة تعليمية، أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's Name: اسم الطالبة: هنا فايز يوسف عبد الله

Signature: التوقيع :

Date: التاريخ: ١/٦/٢٠١٤

Table of Content

List of Table

List of Figure

Abbreviations

BOD	Biological Oxygen Demand
CEPA	California Environmental Protection Agency
COD	Chemical Oxygen Demand
EC	Electrical Conductivity
EQA	Environment Quality Authority
EFSA	European Food Safety Authority
EPA	Environmental Protection Agency
FAO	Food and Agricultural Organization
GIS	Geographic Information System
HPLC	High pressure liquid chromatography
IPM	Integrated Pest Management
MRLs	Maximum Residue Limits
MESD	Ministry of Environment and Sustainable Development, Mauritius
PHI	Pre-Harvest Interval
ppm	Part per million
SPSS	Statically Package for Social Science
TDS	Total Dissolve Solid
TF	Transfer Factor
WHO	World Health Organization

Evaluation of the impacts of uncontrolled agricultural practices on soil and water resources on the Al-Far'a catchment

By
Do'a Fayez Abdullah
Supervisor
Prof. Marwan Haddad

Abstract

Most of the agricultural land and ground water in Al-Far'a catchment are being excessively used with the absence of proper management. Uncontrolled agricultural practices could cause pollution through the release of several pollutants, such as agrochemicals (pesticides and fertilizers), manures, and heavy metals into receiving waters, soils and crops.

In order to assess and evaluate the impacts of uncontrolled agricultural practices on groundwater, soil and crops in Al-Far'a catchment. Water samples from 33 different agricultural wells were collected and analyzed to detect the presence of nitrates (NO_3^-), phosphate (PO_4^{-3}), COD, BOD, electrical conductivity (EC), hardness, total dissolve solid (TDS) and pH. At the same time, Soil samples at three depths (0-20, 20-50, 50-100 cm) and crops samples (leaves, shoots and fruits) were collected from different areas in the catchment to analyze the accumulation of nitrate, phosphate, heavy metals (Fe, Cu, Zn, Cd, Pb and Ni) and lufenuron and abamectine pesticides residues.

Field questionnaire was prepared and distributed to gather data from 155 farmers in different places in the catchment. The data was used to

investigate and characterize the agricultural activities that were practiced by farmers in the catchment.

The results showed that one out of 33 wells contained nitrate level that exceeded the WHO standards for drinking water. One well contained phosphate level that exceeded the EU standards for drinking water and the FAO standards for irrigation water. The water in the wells was very hard, while the levels of TDS, EC and pH in the wells were found within the permissible limit of the WHO standards for drinking water and the FAO standards for irrigation water. The level of COD in two wells and BOD level in eight wells were higher than the allowed concentration for irrigation water quality.

The results showed that the level of phosphate on soil samples were higher than the recommended environmental level of phosphate soil content and crops need, the highest level of phosphate was detected at the top soil. Soil was polluted by nitrate and the highest nitrate level was detected at 20-50 cm depth. Heavy metals levels were lower than the maximum allowable limit of the WHO standards. The order of heavy metals level in soil was Fe > Zn > Ni > Cu > Pb > Cd. Although heavy metals levels in soil were within the permissible limit, however the ongoing agricultural practices could lead to increased accumulation of heavy metals in soil. Analysis showed considerable residues of lufenuron and abamectine pesticides in soil and the highest level was at top soil.

The nitrogen level in cucumber and aubergine was found within permissible the WHO standards. Phosphate and nitrate concentrations recorded higher levels in leaves than other parts of both crops. Cucumber showed more ability to accumulate nitrogen and phosphate than aubergine. The order of Heavy metals levels in the two crops was Fe> Zn> Cu>Ni >Pb > Cd. Noting that the accumulation of heavy metals in cucumber were higher than its accumulation on aubergine. In both crops, Ni and Cu levels were below permissible the WHO standards. It was noticed that Cd and Pb levels (in all parts of the two crops), Fe level (in leaves and shoots of the two crops) and Zn level (in aubergine shoot) were found higher than the maximum allowable limit of the WHO/FAO standards. Lufenuron pesticide residues in green bean were found at levels above the permissible limit of the EU standards and the level of abamectin pesticides residues in aubergine was higher than the permissible limit of the WHO/FAO standards.

The results of field questionnaire revealed that the average level of knowledge and perception of the respondents about agrochemicals is moderate. Most of the Al-Far’a farmers have finished secondary school and part of them have university degree, this enables them to accommodate new technologies in plant protection. Most of the farmers try to take some measures to prevent wells pollutions. Most of the Al-Far’a farmers do not receive any training to deal with pesticides and do not have the enough knowledge about the modern techniques and alternatives for using pesticides. Al-Far’a farmers consider pesticides as the best solution for them.

Chapter One

Introduction

1.1 Introduction

Food and fiber productivity soared due to new technologies, mechanization, increased chemical use and governmental policies that favored maximizing production. Although these changes have had many positive effects on farming, there have also been significant costs. Prominent among these is the degradation of soil and water resources (Zalidis et al., 2002).

Agricultural activities create pollution through the release of several materials, such as sediments, pesticides, animal manures, fertilizers and other sources of inorganic and organic matter into receiving waters and soils, and these pollutants can be transfer to food chains. (Esen and Uslu, 2008).

During the last few decades, widespread contamination and toxic effects of organic chemicals have become a serious environmental problem. They enter the soil by direct treatment or by being washed off from the plant surface during rainfall. Their physico-chemical characteristics, which include hydrophobicity and resistance to degradation, make these chemicals accumulate in soils and sediments (Richa, et al., 2011). In the West Bank and Gaza Strip, the excessive uncontrolled use of chemicals (e.g. DDT, lindane, a-benzene hexachloride, organochlorine, and organophosphate) for pest control and plant disease abatement has been a major issue of land based food production. Increased agricultural productivity in the WB and GS has been achieved through intensified use of arable land with massive application of a variety of pesticides and fertilizers. This has led to speculation as to increased breast cancer in the Gaza Strip, and contamination of cow’s milk (Al-Saed et al., 2011).

The excessive usage of fertilizers usually increased the ability of the soil to retain and transform the nutrients and synchronize the availability of nutrients with crop needs. In many cases, the increasing amount of concentration of nitrogen or phosphate in soil has led to the movement of nitrate and phosphate into groundwater (Zalidis et al., 2002).

Heavy metals are serious pollutants for agricultural lands due to their toxicity, persistence in natural conditions and ability to enter and accumulate into food chains (Zhang et al., 2010). Industrial or municipal wastewater is mostly used for the irrigation of crops due to its easy availability, disposal problems and scarcity of fresh water. Irrigation with wastewater is known to accumulate its' heavy metals content in soil (Arora et al., 2008). The Long-term use of inorganic and organic fertilizers in agricultural lands increases the level of heavy metals in agricultural soils. Metal accumulation in soil is likely to gradually generate health and environmental risks (Santos et al., 2008). Heavy metal and other pollutants can be built up and accumulated. These chemicals have been detected in agricultural and animal products such as fruit, vegetables, meat and milk. The consumption of these products can adversely and acutely affect health and cause chronic diseases.

In Al-Far’a catchment, the agricultural sector is considered as the main economic activity. Due to that, farmers have adopted several practices to harness the highest possible yields, both in quantity and quality, in a relatively short time with reduced efforts. Agrochemicals (fertilizers and pesticides) are considered extremely important inputs and integral components of crop production system in the catchment. Both of these inputs are essential to increase yield and reduce lost crops. Therefore, the intensive use of pesticides and fertilizers in an uncontrolled way, and the use of wastewater in irrigation are the most common uncontrolled activities that have significant sources of pollution in the catchment. Therefore, soil and water resources (wells and springs) are exposed to degradation and pollution (Al-Fars.2007).

This research aims to investigate and characterize the agricultural activities being practiced by Al-Far'a farmers and then evaluate the effect of concentration of heavy metals, nitrate, phosphate and organic matter as pollutants from agricultural practices on water and soil, and potential transport to crops.

1.2 Research objectives

The general objectives of this research can be summarized as follows:

- To investigate and characterize the agricultural activities of farmers in Al-Far'a catchment.
- To determine the level and investigate pollutants transport from agricultural activities (heavy metals, nitrate, phosphate and organic

Lufenuron, abamectin pesticides) in soil and water wells in Al-Far'a catchment.

- To detect and evaluate the residue of pollutants from agricultural activities (heavy metals, nitrate, phosphate and Lufenuron, abamectin pesticides) in crops in Al-Far'a catchment.

1.3 Research Questions

Further to the above objectives, a few questions are raised:

- What are the quantitative and qualitative extents of uncontrolled agricultural practices in Al-Far'a catchment?
- What are the effects of uncontrolled agricultural practices on soil, water quality in Al-Far'a catchment?
- What are the potential transport and transfer of the different pollutants to the food chain through crops gardening?

1.4 Motivation

The most important economic sector in Al-Far'a is the agriculture sector. Farmers in the catchment have practiced many agricultural activities to get higher levels of productivity. Some of these practices are improperly managed, so the need was raised to study such topic. The incentives that encouraged this research are:

- The intensive agriculture in Al-Far'a catchment leads to environmental degradation and pollution through the intensive use of agrochemicals, improper management of agricultural waste and the use of wastewater in irrigation.

- The lack of researches that study the effects of uncontrolled agricultural practices on soil, water quality and plant in Al-Far'a catchment.
- The improper use of waste water and agrochemicals in the agricultural practices release pollutants that have the potential to enter the food chain and cause adverse health effects.
- The identification of self-reported toxicity symptoms associated with pesticides in Al-Far'a catchment.

1.5 Case Study Description:

1.5.1 Location and Topography

Al-Far'a Catchment is one of the major arteries of draining into the Lower Jordan River. Geographically, it is located in the northeastern part of the West Bank, Palestine, and has a total area of about 320 km^2, accounting for 6% of the total area of the West Bank (Figure 1.1) (Shadeed and Lange, 2010). Al-Far'a catchment overlies three districts of the West Bank. These are Nablus, Tubas and Jericho districts. Al-Far'a catchment lies within the Eastern Aquifer Basin (EAB).

Al-Far'a catchment is divided to three parts: these are the upper part (Ras Al-Far'a), the middle parts (Wadi Al-Far'a, Al-Bathan, Talluza, Beit-Hassan, Ein Shibli, Froush Beit Dajan and An-Nassariyya) and the lower parts (Al-Jiftlik).

Topography is a unique feature of Al-Far'a catchment which starts at an elevation of about 920 meters above mean sea level in the western edge of the catchment in Nablus Mountains and descends drastically to about 385 meters below mean sea level in the east at the confluence with the Jordan River (Figure 1.2), (Shadeed ,2008) (Saleh, 2009) (Abdel- Kareem, 2005).

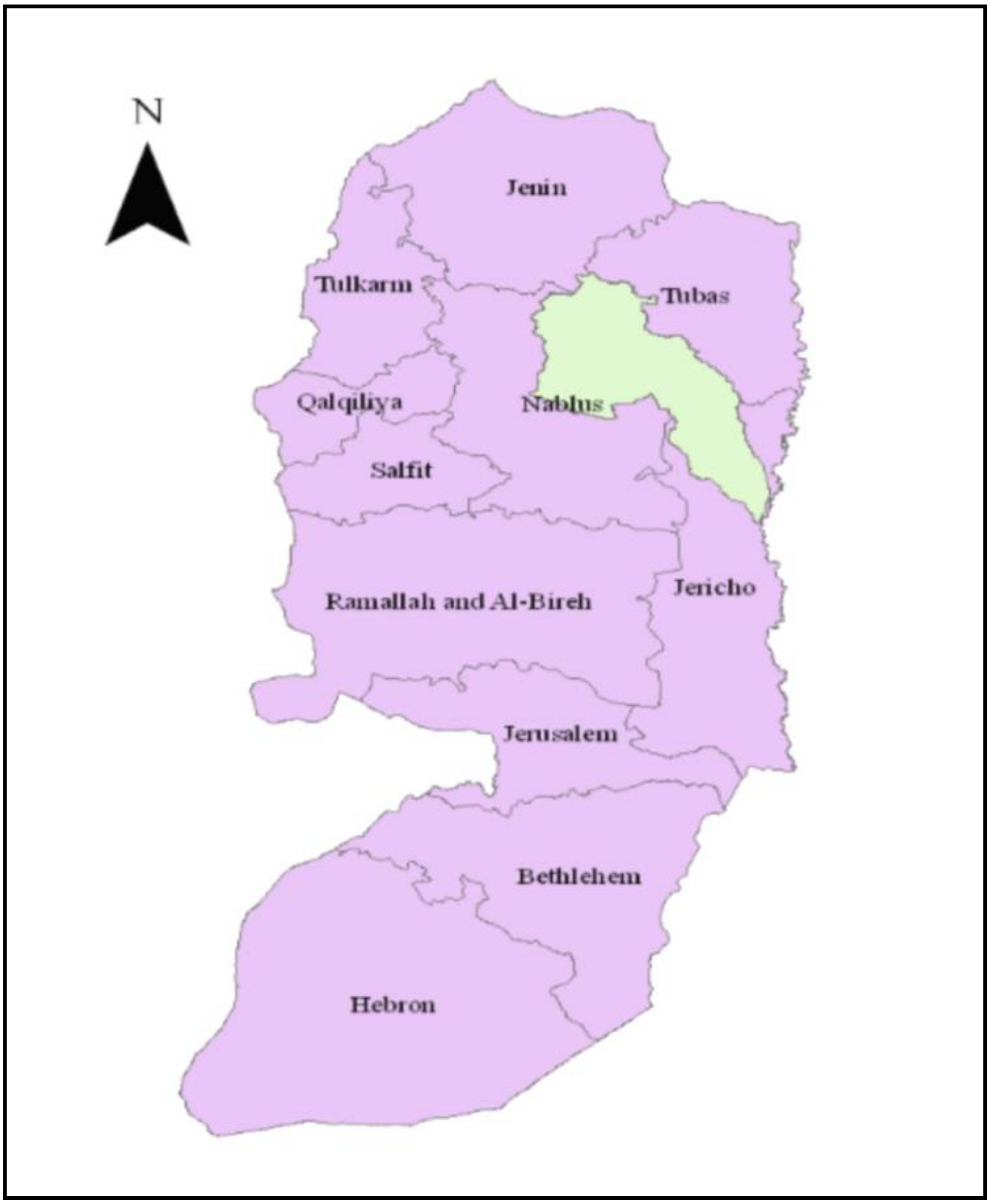


Figure (1.1): Location of the Al-Far'a catchment in the West Bank (Saleh, 2009)

This means that topographic relief changes significantly throughout the catchment. In less than 30 km there is a 1.25 km change in elevation (Abdel Kareem, 2005).

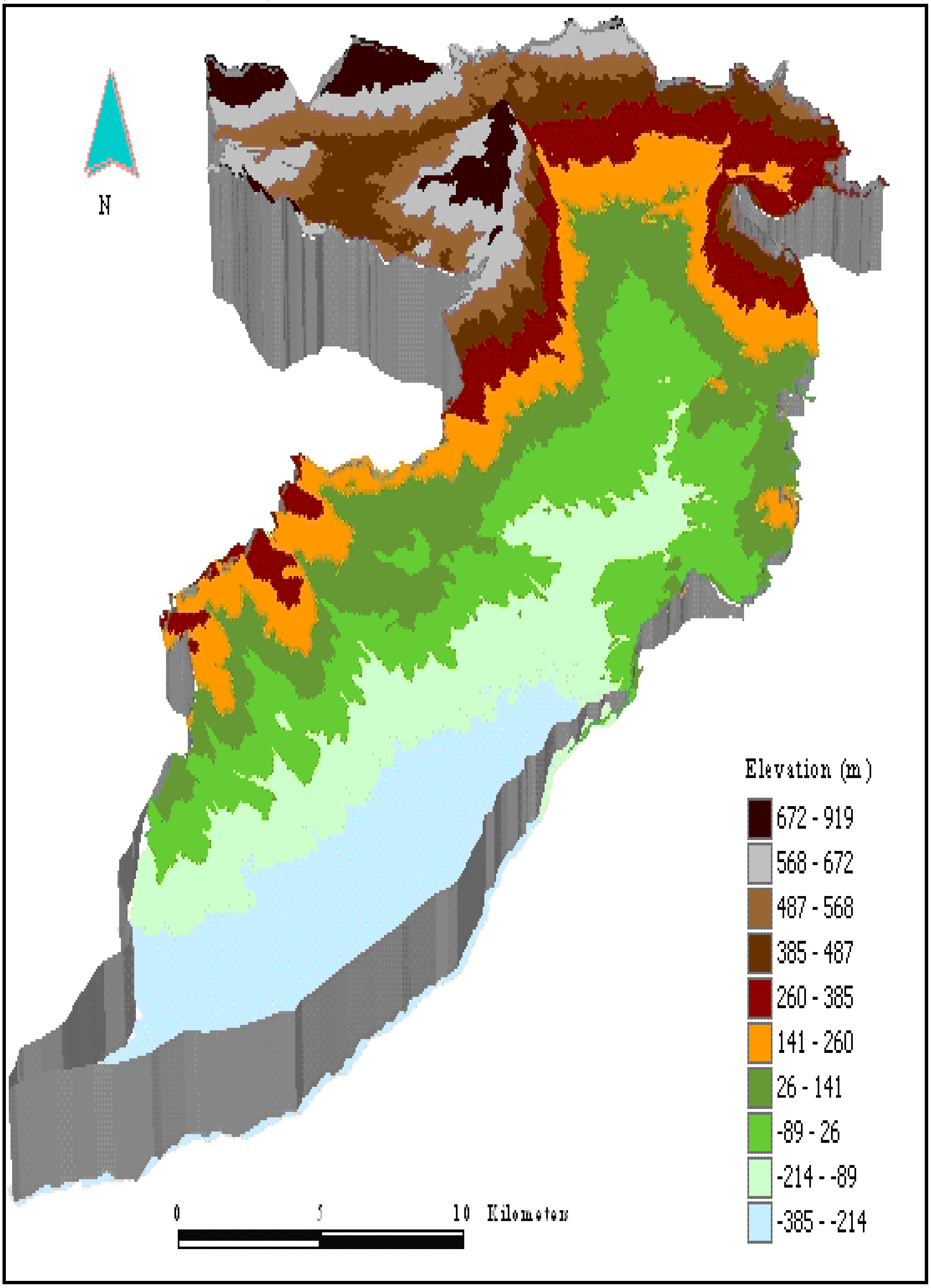


Figure (1.2): Topographic Map of Al-Far'a Catchment

1.5.2 Climate and Rainfall:

Al-Far'a catchment is characterized with mild rainy winters and moderately dry, hot summers and has Mediterranean semi-arid climate. The climate is highly variable and is influenced by both elevations and the circulation of the air-streams. From October to April, seasons are rainy winter in the catchment. The rainfall distribution within the Al-Far'a catchment ranges from 640 mm at the headwater to 150 mm at the outlet to Jordan (Abdel Kareem, 2005), the average rainfall in the upper part in the catchment exceeds 400 mm, while it is from 200 to 400 mm in the middle part and less than 200 mm in the lower part of the catchment (Shadeed, 2008). Therefore, Precipitation decreases from west to east and from high to low altitudes (Saleh, 2009)

1.5.3 Land Use:

There are four classes of land use in Al-Far'a catchment as shown in (Table 1.1). The Table shows that the non–agricultural land is the most dominant class (Figure 1.3).

Rural communities are the major communities in the catchment, except where the refugee camps in the eastern part of the city of Nablus are located. The major economic activity followed in the area is agriculture because of the diversity of climate, soil fertility and the availability of water sources (springs and wells).

Agricultural land in Al-Far'a catchment is divided into two classes according to irrigation types. There are irrigated agricultural land and rain-fed agricultural land.

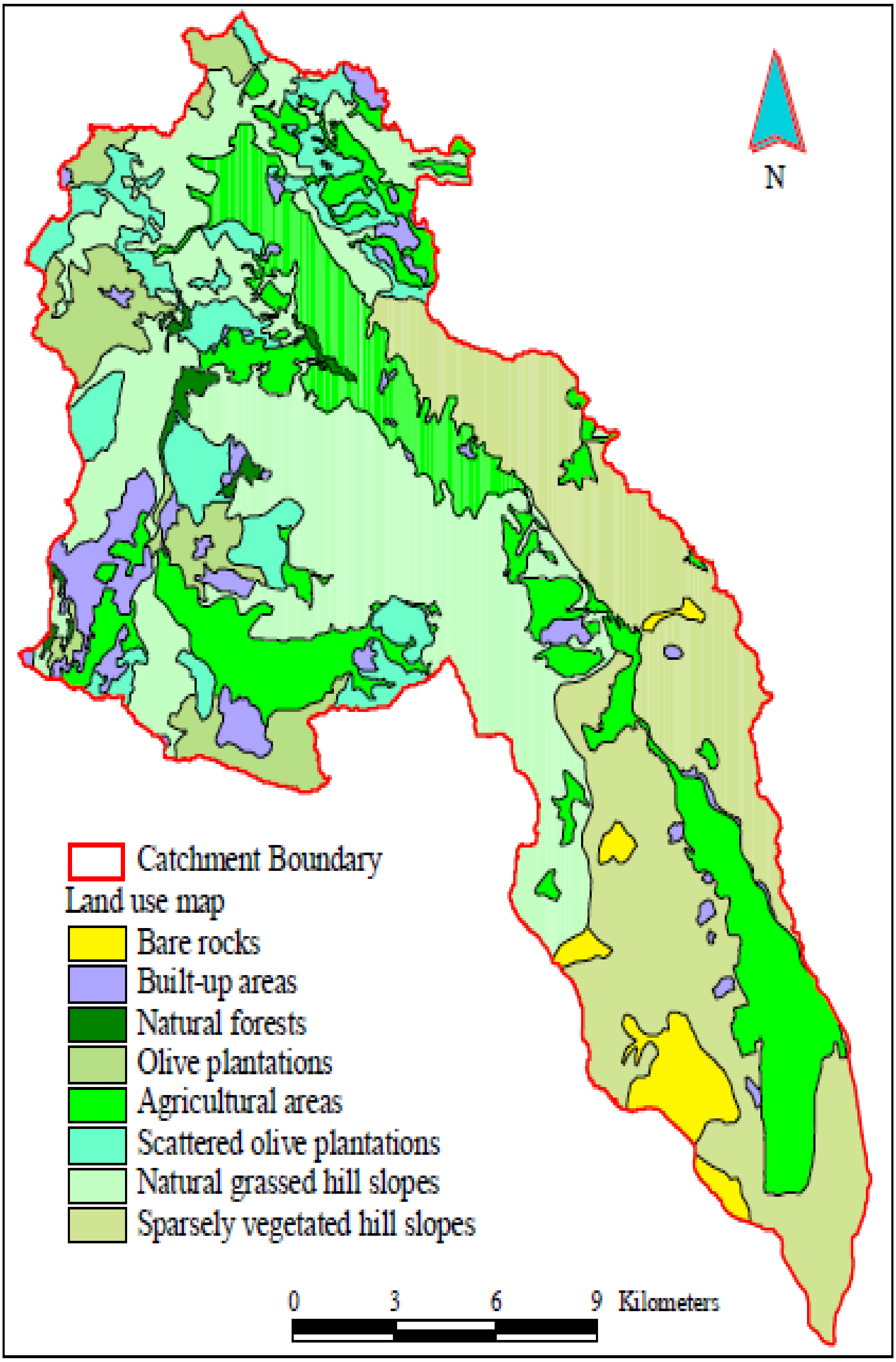


Figure (1.3): The Developed Land Use Map of the Al-Far'a Catchment (Shadeed, 2008).

Table (1.1): Land use classes in Al-Far'a catchment (Saleh, 2009)

Land cover	Area (dunum)	Area (%)
Artificial surfaces		
Refugee camps	900	0.3
Discontinuous urban fabrics	10488	3.2
Israeli colonies	2885	0.9
Military camps	649	0.2
Construction sites	817	0.2
Total	15739	4.8
Agricultural areas		
Non-irrigated arable land	27521	8.3
Drip- irrigated arable land	13847	4.2
Vineyards	71	<0.1
Drip irrigated vineyards	16	<0.1
Olive groves	25465	7.7
Palm groves	347	0.1
Citrus plantations	4722	1.4
Others	594	0.2
Non-irrigated complex cultivation pattern	4568	1.4
Irrigated complex cultivation pattern	15388	4.6
Land principally occupied by agriculture	32251	9.7
Total	124790	37.7
Forests and semi natural vegetation		
Broad leave forests	118	<0.1
Coniferous forests	2569	0.8
Natural grassland	105398	31.8
Sclerophyllous vegetation	124	<0.1
Transitional wood land	415	0.1
Bare rock	12937	3.9
Sparsely vegetated area	66353	20.0
Halophytes	1773	0.5
Total	189687	57.2
Wet lands/ inland marshes	54	<0.1
Water bodies/ artificial surfaces	886	0.3

Rain-fed agricultural land is mainly located in the upper parts of the catchment because of the high amount of rain in the upper parts compared to the lower parts. The non- irrigated trees, like olive trees, are the major rain-fed crops that are most heavily concentrated in Al-Bathan and Talluza. There are about 1075 dunums of non-irrigated vegetables in the catchment (Table 1.2).

Irrigated agriculture is the major agricultural type in Al-Far'a catchment and it is considered the base of economy in Palestine and Al-Far'a catchment. Irrigated agriculture includes open field vegetables, greenhouses and irrigated trees.

The most important crops farmed in Al-Far'a catchment and the West Bank are irrigated vegetables. There are more than 20000 dumums of Irrigated vegetables lands in the catchment. Citrus trees are the main irrigated trees planted by farmers in the catchment, illustrated in Table (1.2).

Table (1.2): Summery of agricultural patterns in Al-Far'a catchment (EQA, 2006).

Agricultural areas of Wadi Al-Far'a	Total for irrigated vegetables	Total area for non-irrigated vegetables	Total area for irrigate d trees	Total area for non-irrigated trees	Total areas for rain fed field crops	Total area for irrigated field crops
Bathan and Talluza	39	54	245	9943	120	5
Ras Al-Far'a	4346	210	478	540	950	150
An-Nassariyya	3156	811	1342	2	4550	557
Froush beit dajan	132	0	1298	0	361	5
Al-Jiftlik	13315	0	307	0	0	1325
Total	20997	1075	3670	10485	5981	2042

Beside the agricultural sector, there are a few small industrial and commercial activities in Al-Far'a catchment. Moreover, there are a few recreational activities, especially in the upper parts of the catchment, which have touristic facilities.

1.5.4 Water Resources:

Surface water or ground water is the main sources of water in the catchment. Most of the rain is lost in the winter due to the lack of water storage structure.

There are 70 wells in Wadi Al-Far’a, of which 62 are agricultural, three are domestic and five are utilized by Israel. The annual total utilization of the Palestinian wells ranges between 4.4 and 11.5 MCM/year (Shaheen et al., 2007). Ras Al-Far’a, Al-Aqrabanieh, An-Nassariyya, Froush Beit Dajan and Al-Jiftlik along the flexure of Wadi Al-Far’a are the areas where wells are mainly located (Figure 1.4).

Springs are the only natural drainage outlets for groundwater in Al-Far’a catchment. Within the Al-Far’a catchment, 13 fresh water springs exist divided into four groups: Al-Far’a, Bathan, and two springs are utilized by the city of Nablus. Most of the springs are located in the upper and middle parts of the catchment (Figure 1.4).

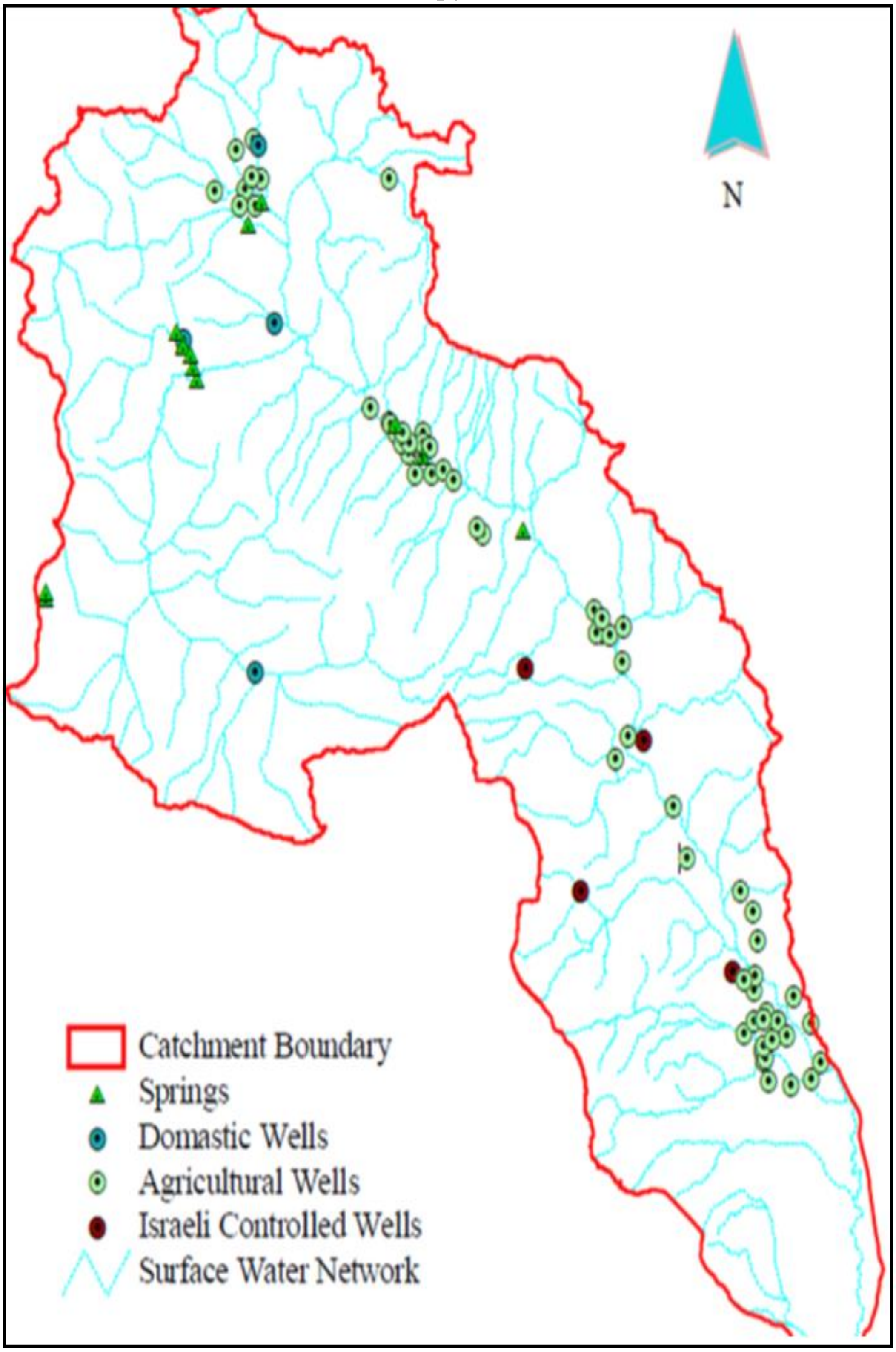


Figure (1.4): Location Map for springs and Wells in Al-Far’a Catchment (Shadeed, 2008)

Al-Far'a and Al-Badan streams are the two main streams contributing to the Al-Far'a catchment. These streams meet at Al-Malaqi Bridge located 12 km east of Nablus city. The Al-Far'a wadi is the major water supply system in the catchment. Springs are located around the stream and discharge water to the stream, through which water is conveyed to irrigation ditches and pipelines that distribute irrigation water to the farms along both sides of the stream (Abdel Kareem, 2005). Al-Far'a catchment has the highest surface run off compared with other catchments in the West Bank, although that stream flow in Al-Far'a is polluted because Al-Bathan stream is mixed with untreated industrial and domestic wastewater effluents, while Al-Far'a stream is polluted by Al-Far'a Refugee camp discharges and untreated domestic wastewater.

Chapter Two
Literature Review

2. Pollutants Derived from Agricultural Practices

Agriculture can produce positive benefits to the environment and to the human. At the same time, the agricultural activities can be harmful to the environmental elements quality by polluting soil, water and air by agrochemicals and agricultural waste. Some of these pollutants will be discussed in the following sections.

2.1 Fertilizers

Any natural or manufactured material, which contains at least 5% of one or more of the three primary nutrients (N, P_2O_5, and K_2O) can be called fertilizer. Industrially manufactured fertilizers are called mineral fertilizers (FAO, 2000). Crops absorb nutrients from the soil, but if the soil cannot supply them with essential minerals, fertilizers can be added to the soil to increase its' fertility and nutrients content.

Fertilizers are divided into two groups: the first group is organic or natural fertilizers, these include manure, animal waste and compost or wood ash. The second group includes manufactured or inorganic fertilizers, this group has three main types of nutrients: nitrogen (N), phosphorus (P) and potassium (K). There are other types of inorganic fertilizers such as Iron, calcium, magnesium and others.

2.1.1 World Demand of Fertilizers Nutrients

The total fertilizer nutrient (N, P_2O_5 and K_2O) consumption was estimated at 161.7 million tonnes in 2009 and it reached 169.7 million tonnes in 2010. With a successive growth of 2.6 percent per year, it is expected to reach 187.9 million tonnes by the end of 2014. (Table 2.1) indicates world demand for total fertilizer nutrients from 2010 to 2014 (FAO, 2010).

Table (2.1): World demand for fertilizer nutrients, 2010-2014 (thousand tones). (FAO, 2010).

Years	2010	2011	2012	2013	2014
Nitrogen (N)	103.877	106054	107901	109835	111638
Phosphate P_2O_5	39148	40445	41594	42791	43876
Potassium (K_2O)	26655	28542	29882	31218	32413
Total ($N+P_2O_5+K_2O$)	169680	175041	179377	183844	187927

The world (N, P_2O_5 and K_2O) fertilizer demand is expected to increase from 2010 to 2014 duo to the increased population growth and increased crops production.

2.1.2 Fertilizers Impacts on the Environment

In recent years, intensive fertilizer consumption has occurred throughout the world, which causes serious environmental problems. Fertilizers may accumulate or affect the accumulation of heavy metals in soil and plant system. Because crops absorb the fertilizers through the soil, they can enter the food chain. Thus, fertilization leads to water, soil, air and food pollution (Savci, 2012).

2.1.2.2 Fertilizers Impacts on Water Resources

Groundwater is an extremely important resource and pollution of groundwater resources is a matter of serious concern. Therefore, agriculture significantly contributes to groundwater pollution through leaching agrochemicals. (Jeyaruba and Thushyan, 2009).

Nowadays, human beings are aware of leaching nitrate and phosphate for many reasons: First, the harmful effects of these chemical on human health.

Second, enhanced N loading can alter nutrient balances and ecological processes in rivers, lakes, and estuaries, potentially leading to eutrophication, net phytoplankton productivity, and increased bottom water hypoxy (WRiley et al., 2001). Finally, there is a risk of economic loss for nitrate and phosphate leaching.

Nitrogen and phosphate in agricultural areas reach to water environment in three ways: Drainage, leaching and flow (Savci, 2012).

There are many studies, which confirm the deterioration of water quality due to the application of nitrate and phosphate fertilizers.

The increasing use of artificial fertilizers, the disposal of wastes (particularly from animal farming) and changes in land use are the main factors responsible for the progressive increase in nitrate levels in groundwater supplies over the last 20 years. In Denmark and the Netherlands, for example, nitrate concentrations are increasing by 0.2–1.3 mg/l per year in some areas. Because of the delay in the response of groundwater to changes in soil, some endangered aquifers have not yet shown the increase expected from the increased use of nitrogen fertilizer or manure. Once the nitrate reaches these aquifers, the aquifers will remain contaminated for decades, even if there is a substantial reduction in the nitrate loading of the surface (WHO, 2011).

Jeyaruba and Thushyan, (2009) focused in their study on the impact of agriculture on quality of ground water in Jaffna, Sri Lanka. 86 wells were selected from different cropping system (High land crops, mixed crops, Banana Paddy, water sample were drawn for period of six consecutive months beginning from July 2007 to February 2008. The results revealed that there was a good correlation between cropping system and nitrate-N concentration in groundwater. High nitrate-N concentration of groundwater was observed at high land crops followed by mixed crops (Jeyaruba and Thushyan, 2009). The results found that 81% of the well is not suitable for drinking water because of the high concentration of nitrate. The results of pH were ranged from 6.9-8.1. The normal recommended pH range for irrigation water is from 6.5 to 8.4(Jeyaruba, Thushyan, 2009).

Young et al., (2009) studied the effect of agricultural practices on ground water characters in two heavily agricultural areas (Talawa and Giribawa) within the Kala Oya River Basin, where there were intensive use of fertilizers. 296 weekly sampling was carried out at 20 locations within the two selected areas. The result of the study indicated that high nitrate concentration was found in almost all surface waters, but the lowest nitrate range is found in the canals. The highest phosphate concentrations were found in the lakes, and the lowest values were found in the canals. In addition, the nutrient (nitrate and phosphate) were found in wells. The cations were found in all types of ground water in high concentration. Mg and Ca concentrations are the highest in streams and canals, while Mn and Fe concentrations are the highest in lake. pH is higher than 7 in dug well .

Mahvi, et al. (2005) studied the impact of agricultural activities on groundwater nitrate pollution in Tehran, Iran. In total 168 samples from 42 wells during the months of April, May, August, and September of 2004. The results observed at all samples showed that nitrate concentrations are below the EPA (environment protection agency) MCL (44.27 mg/l) and WHO guideline (50 mg/l). In addition, the highest concentration of nitrate is obtained in 2004. Besides, the results showed that the lowest concentration of nitrate in water wells that are located near the Dez River, because of the continual recharge from river. There are correlations between N-fertilizer application and nitrate content (R=-0.69). This correlation suggests an inverse proportion between N-fertilizers application rate and groundwater nitrate concentration, because of different soil characteristics in each sub-regions and present confining layers, more washout of farm topsoil’s N-fertilizers (Mahvi, et al., 2005).

Nikolaidis et al., (2007) studied the impact of intensive agricultural practices on drinking water quality in the Evros Region which is one of the largest agricultural areas in Northern Greece. They found that the level of nitrate exceeds 50 ppm, which is the European Commission drinking water limit in 4 samples, beside that the nitrate level ranges from 2-212 ppm in 64 ground water samples, while phosphate concentrations ranged from 0.2 to 6.28 ppm. About 7.8% of samples contained phosphate concentrations exceeding the EC recommended value of 5 ppm (Nikolaidis et al., 2007).

Divya and Belagali (2012) studied the impact of chemical fertilizers on water quality in selected agricultural areas of Mysore District, Karnataka, India. The results showed that the phosphate concentrations ranged from 2.20 to 4.23 mg/l in ground water, 1.87 - 3.89 mg/l in lake water and in canal water phosphate level was 1.87 to 3.89 mg/l. It was indicated that the fertilizers phosphate is the major source of enrichment of phosphate in water samples. While it was found that nitrate level exceeds the standard World Health Organization (WHO) limit (50 mg/l) in all water samples except 2 samples. Where the concentration of nitrate ranged from 100 to 1650 mg/l in ground water samples, 40 to 540 mg/l in lake water and 20 to 120 mg/l in Canal water.

Kim et al. (2011) studied the route of Phosphorus losses transport from agricultural soils to surface waters in a small agricultural watershed. Samples were collected from soil at depth 0-50 cm, and run off from two upland sites during the cultivation period and Water samples of surface water and waterbed flow were collected from the stream close to runoff sampling. It was found that Phosphorus concentrations in the runoff water and stream water ranged from 0.20 to 2.29 mg /L and from 0.04 to 0.30 mg /L, respectively. There was high relationship between soil P and the P in runoff by value R^2= 0.87. In addition, dissolved P concentrations in runoff was closely related to the dissolved P concentration of stream water (R^2= 0.73). The results of analysis of P in surface water and waterbed flow indicated that the concentration of P in bottom flow of the stream was at high level throughout the experimental period. Moreover, results found that the concentration of P was higher in spring and dry seasons than winter because of the undisturbed deposit of P in sediment during rain time. The results and relations above indicate that phosphorus losses from agricultural soils to surface waters.

The intense agricultural practices especially in the vegetable cultivations have caused high cations and nutrients in water of agricultural wells, dug wells and lakes due to recycling of the same water several times a year. In addition, the high cations in the deep groundwater are due to high rock interaction that is a natural process (Young et al., 2009).

2.1.2.2 Fertilizers Impacts on Soil.

The intensive use of chemical fertilizers leads to a damage in the soil quality and pollutes it with unwanted elements like heavy metals. For example, the excessive use of fertilizers can decrease soil fertility, increase soil acidity due to accumulation of NO_3, PO_3, Na, K and Cd and decrease the pH of the soil leading to a decrease in the crop yield and its' quality. Moreover, increasing the levels of phosphorus and nitrate in the soil can lead to nutrients imbalance, thus, reducing productivity.

Accumulated fertilizers in the soil increases salinity which leads to raising osmotic pressure of the soil solution. This reduces the amount of water which can be absorbed by plant. Moreover, it was found that the presence of high fertilizers concentrations in the soil restricts the growth of microorganisms that is required to reduce fertilizers.

Fertilizers are converted to nitrate through nitrification by microorganisms. Due to the negative charge of nitrate, it can reach ground water. Even in ideal conditions, Crops use 50% of nitrogenous fertilizers applied to soil, 2-20% is lost through evaporation, 15-25% reacts with organic compounds in the clay soil and the remaining 2-10% interfere surface and ground water (Savci, 2012).

Crop type has a significant effect on nitrate accumulation in soil. Grass and fruit trees show the lowest nitrate residues, followed by sugar beets, Potatoes and vegetables give on average the highest nitrate level. Maize and cereals give intermediate values (Tits et al., 2008).

Many researchers studied nitrate accumulation resulting from fertilizers use on soil and from leaching. Rehman, et al., (1999) found in their study carried out in Pakistan that after applying fertilizers, the highest level of nitrate was found at 25 cm depth, then nitrate level was decreased by increasing depth. However, after the dry period, the results indicated that the maximum concentration of NO_3 was observed at a depth of 65 cm, below this depth the level of nitrate decreased. The results suggest that higher nitrate level, when the dose of fertilizers increase, lead to more nitrate leaching into deeper soil layers even at the first irrigation.

Pez-Bellido et al., (2013) studied the effect of the tillage system, crop rotation and N fertilizer rate on accumulation of nitrate in soil in Mediterranean Vertisol. The results showed that the content of nitrate levels in the 0–90 cm soil profile ranged between 37 and 191 kg N/ha, depending on the year. The highest nitrate level found with the application of 150 kg N/ha where nitrate level was 145 kg NO_3^--N /ha, the nitrate content was higher at depth 30-60 cm and 60-90 than 0-30 cm where the average nitrate level was 26,56,39 kg/ha at 0-30,30-60,60-90 cm, respectively between 2006-2009. The results found that for crop rotation, the highest amount of nitrate was in the wheat–fababean rotation (139 kg/ ha), followed by wheat–wheat, wheat–fallow, wheat–chickpea and wheat–sunflower (124, 117, 104 and 55 kg NO_3^--N/ ha respectively). The nitrate level in soil was affected by tillage system, the nitrate concentrations were lower in no-tillage system than on average under conventional tillage (104 and 112 kg NO_3^--N/ ha, respectively).

In a study conducted by Hoodaa et al., (2001) in UK. Researchers studied the effect of manuring and using fertilizers on phosphorus accumulation in soils and potential environmental implications. The result found that the range of P content was 447 to 2320 mg/kg. The results showed that the highest P content was in samples taken from farms that used P fertilizers for the longest periods of time in their history. Besides that, the results showed that P content increases in soil with P-fertilizers application Increase. The soil samples which were collected from two site that were treated by manure sewage sludge showed that the highest accumulation of P in soil and lowest P-sorption capacity where High-Pin two sites were 606 and 853 mg /kg. The mean DSSP (degree of soil saturation with P) ranged from 5.2-42.4%, and the highest DSSP found at site received the largest P-inputs. The results suggested that the increased treatment with P fertilizer /manuring lead to increase in P-content and p-saturation in soil and decrease of P-sorption capacity. As a result, the P loss in runoff from these soils increased.

2.1.2. Accumulation of Fertilizers in Crops:

Crops adsorb nitrate and phosphorous from soil by root, and these elements are important for plant growth. Nitrate contamination in vegetables occurs when crops absorb more than they require for their sustainable growth (Prasad and Chetty, 2008).

Nitrate was determined in some of vegetables in Korea by (Kim et al., 2011), they found that nitrate contents of the conventional farming for agricultural product collected ranged from 94.5 mg/kg to 4875.8 mg/kg. In addition, it was found that the highest content of nitrate was detected in Radish leaves (4875.8 mg/kg) marshmallow (4711.8 mg/kg). The lowest nitrate level was found in pepper, onion, and lotus root where nitrate level was less than 1000 mg/kg. The result suggested that leafy vegetables like radish leaves, marshmallow, crown daisy, cabbage and spinach contain nitrate more than 3000 mg/kg. Besides that, leafy vegetables can accumulate nitrate higher than root and fruiting vegetables.

In a study conducted by EFSA 2008 in Europe to determine nitrate in several types of vegetables, the results found that Brassica vegetables had a level of nitrate range from 40 to 200 mg/kg, except Chinese cabbage and kohlrabi with concentrations around 900 mg/kg. Bulb vegetables showed low level of nitrate like onion. For fruiting vegetables, the highest concentrations reported in pumpkin with average mean 894 mg/kg, the nitrate level in cucumber was 185 mg/kg. Leafy vegetables had the highest level of all groups. The highest nitrate value recorded in the group, 19,925 mg/kg, belonged to an oak-leaf lettuce sample grown under cover in Norway. In this group, Rucola had the highest level of nitrate but watercress had the lowest with mean level 4677 and 136 mg/kg, respectively. While level of nitrate in legumes, stem, Roots, and Tubers was 221, 698 and 506 mg/kg respectively. By region, the highest level on nitrate found from vegetables for Germany followed by Romania and the lowest Greece.

In a study conducted in Jordan by (Amr and Hadidi, 2001), several vegetables were grown under open-field and greenhouse conditions were analyzed to detect nitrate level. The results found that the highest level of nitrate was found in squash followed by cabbage with averages of 4.13 and 3.40 mg /100 g respectively and the lowest level was obtained in cauliflower with average 0.13 mg /100 g. The results of vegetables grown under greenhouse showed that the highest level of nitrate obtained in squash followed by cucumber 4.77 and 2.31 mg /100g, respectivelyand the lowest was in tomatoes 0.74 mg/100g. Nitrate level in squash grown in green house was higher than that from open field because Greenhouse vegetables receive more intensive nitrogen fertilization, although they are irrigated more often. Harvest date had a significant ($P<0.05$) effect on the nitrate content of spinach, cabbage, and squash. The late-harvested at 11 o’clock vegetables had the lower nitrate content than early harvested at 9 o'clock, because shading and less exposure to sun light increase nitrate accumulation by decreasing reduction of nitrate.

In Palestine, nitrate content was analyzed in several products that were planted in two locations in Tulkarm district by (Abu-Dayeh, 2006). The study results showed that potato contained the highest levels of nitrate content with an average of 231.84 mg/kg in location 1 and 274.42 mg/kg in location 2. While tomato fruits showed the lowest nitrate content among all the tested vegetables (17.95 mg/kg in location 1 and 15.96 mg/kg in location 2). The averages of nitrate in cucumber, onion, cabbage in two locations were (119.54 and 176.35 mg/kg), (49.79 and 49.88 mg/kg) and (85.23, 198.46 mg/kg), respectively. The results showed that the highest nitrate levels were found in the small fruits than in the large ones in cucumber.

Mejbah Uddin et al., (2012) studied the effect of organic and inorganic fertilizers on phyto-availability of Phosphorous to water spinach in Bangladesh. Obtained results showed that when phosphorous fertilizer application was increasing the phosphorus connection in spinach plant increased. Phosphorus concentration in the shoot of control pot was the lowest of 1188 mg /kg and the highest of 6179 mg/ kg with TSP (800 mg P /kg treatment), while in the roots, the corresponding values were 1171 and 4926 mg kg-1, respectively. The results showed that Triple superphosphate (TSP) is the most accumulated fertilizer in plant, then followed by chicken manure, cow manure and city waste (which was collected from Ananda Bazar of Chittagong City).

Chaves et al., (2010) determined phosphorus determination in vegetables seeds used in the production of biodiesel by Inductively Coupled Plasma/Optical Emission Spectrometry (ICP OES). The results showed that the concentration of P in Cotton seed, Sunflower, Tung, Soybean, Curcas bean, Fodder turnip and Castor bean were 0.59±0.02, 0.67±0.09, 0.30±0.03, 0.58±0.01, 0.58±0.01, 0.72±0.06 and 0.36±0.02%, respectively .

2.1.3 Toxicity of Nitrate and Phosphate

An Average Daily Intake (ADI) for nitrate of 3.7 mg/kg body weight per day, equivalent to 222 mg nitrate per day for a 60 kg adult was established by the former Scientific Committee on Food (SCF) and was reconfirmed by Joint FAO/WHO Expert Committee on Food Additives (JECFA) in 2002 (Kim et al .,2011)(EFSA. 2008).

Nitrates are very toxic matters, which reduce to nitrites at certain physiological conditions in the human body (Kirovaka .2002). If nitrite is present, Hb can be converted to methaemoglobin (MetHb), which cannot carry oxygen. The normal MetHb level in humans is less than 2% and in infant under 3 months of age is less than 3%. When MetHb concentrations reach 10% of normal Hb and above, symptoms of cyanosis (a bluish color of skin and lips) usually appear. At higher concentrations, asphyxia may occur (CFS et al., 2010). High levelof MetHb is associated with clinical signs including cyanosis, impaired aerobic respiration, metabolic acidosis, and death (WHO. 2011).

Nitrite reacts in stomach with nitrosatable compounds to form N-nitraso compounds, these compounds have been found to be carcinogenic (CFS et al., 2010) (Abu-Dayeh, 2006) (WHO. 2011).

The recommended daily allowance for phosphorous is 800 mg and calcium is similar to that. The current average daily dietary intake is approaching 1500 mg, because of the use of phosphorous as food preservative (Finn et al., 2006).

High phosphate intake strongly stimulates lung cancer (Medscape Medical News. 2008). Beside that high-normal serum, phosphate concentration has been found to be an independent predictor of cardiovascular events and mortality (Ritz E et al., 2012). In addition, too much phosphate can cause other health problems, such as kidney damage and osteoporosis (lenntech).

2.2 Pesticides

Farmers around the world use pesticides as first and ideal solution to protect their vegetables from loss by pests and diseases.

2.2.1 Definition, History and Classifications of Pesticides

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest (insects, mites, nematodes, weeds, rats, etc.) (Zhang et al., 2011).

Pesticides usage is known for old ages, farmers used inorganic chemicals to kill insects for example: Ancient Romans killed insect pests by burning sulfur and controlled weeds with salt. In the 1600s, ants were controlled with mixtures of honey and arsenic. By the late nineteenth century, U.S. farmers were using copper acetoarsenite (Paris green), calcium arsenate, nicotine sulfate, and sulfur to control pests in field crops (Delaplane, 1996). However, these chemicals are not effective and unsatisfactory for farmers. So an emergence in pesticide use began after World War II with the introduction of DDT, BHC, aldrin, dieldrin, endrin, and 2,4-D. These new chemicals were inexpensive, effective, and enormously popular for pest control, this is the stage in which the synthetic chemical pesticides were used in agriculture, and these pesticides had a significant mark in food production (Zhang et al., 2011).

Classification of pesticides:

Pesticide can be classified according to the pests they control as follows:

1. Insecticides which kill insects, it contain:

   Organochlorines (as DDT and lindane) Organophosphates (Malathion)

   Carbamate Esters (Carbaryl), Pyrethroids (Permethrin and Cypermethrin), Abamectin and Lufenuron.
2. Herbicides which kill weeds, as Chlorophenoxy compounds, Bipyridyl derivatives and Glyphosate.
3. Fungicides which kill fungi such as Aluminum and zincphosphide.
4. Rodenticides which is used to kill rodents such as warfine and chlorophacinon.

2.2.2 Pesticides Usage in West Bank

In 2004, Palestinians applied about 464 active substances (more than 900 pesticides) (Al-Sa’ed et al., 2011). The Palestinian National Committee identified in 2011 not more than 220 active ingredients that are adequate for use and permitted for application in the agricultural and public health sectors -see appendix (A) (Mann, 2011).

Seven of pesticides are members of the dirty dozen, namely Aldicarb, Chlordan, DDT, Lindane, Paraquate, Parathion and Pentachlorophenol are banned in Palestine. Products marked with asterisks have been internationally suspended, cancelled and/or banned (Ali, 2012). In the West Bank, the annual rate of use of pesticides reached to 502.7 ton (PCBS, 2010). It is estimated that 96.6% of irrigated land and 87.0% of rain-fed land are treated with pesticides in West Bank (Issa et al., 2010). Of total pesticide used, the annual rate of use of insecticides, fungicides and herbicides reached to about 60, 60 and 250 tons, respectively (M. Al-Sadq, personal communication, June, 2014). Beside that there are a sharp decrease (65%) in the annual quantities of the main agricultural pesticides (insecticides, fungicides and herbicides) including soil disinfecting chemicals and other types of pesticides between years 2007 and 1996 in the northern West Bank district (Al-Sa’ ed et al., 2011)

Pesticides are purchased from Israel and distributed to Palestinian farmers through merchants and pesticide distributors at the Palestinian markets (Issa et al., 2010).

2.2.3 Pesticides Investigated in This Study

2.2.3.1 Abamectin Physical and Chemical Properties and Toxicity

Abamectin is the common name for avermectin B1, it is used as miticide, acaricide and insecticide. It is derived from the soil microorganism, Stre~tomvcesavermitilisbacterium (CEPA, 1993). It is a mixture of avermectin $B1_a$ with a molecular formula ($C_{48}H_{72}O_{14}$) and molecular mass (873.1 g/mol) and avermectin $B1_b$ with a molecular formula ($C_{47}H_{70}O_{14}$) and molecular mass (859.1 g/mol), Figure (2.1) shows the structure formula for abamectin. It is practically soluble in water, The brand names of agro chemical products that contain abamectin are Agrimek, Vertimec, Affirm, Avomec and Agri-Mek. These products are used to control mites, sucking insects and leaf miners.

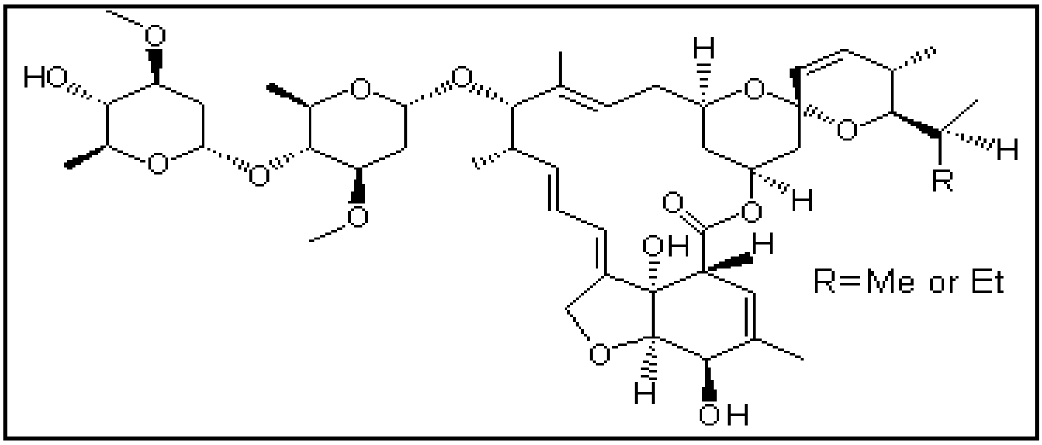


Figure (2.1): Structural formula of abamectin

The oral LD_{50} for abamectin in rats is 11 mg/kg while the dermal LD_{50} for technical on rats is > 330 mg/kg (Bosshard, 1992). EPA set an Acceptable Daily Intake (ADI) for abamectin at 0.0004 mg/kg/day (CEPA.1993). Besides that, it has class II toxicity by the EPA classification. Abamectin has been shown to cause pupil dilation, mild skin irritation, vomiting, convulsions and/or tremors and coma in laboratory animals. Because it is a nerve poison, it can also cause nervous system depression in mammals at very high doses. A study in rats given 0.40 mg/kg/day of abamectin showed decreased lactation, increased stillbirths and an increased likelihood of producing unhealthy offspring, demonstrating a strong chance of similar effects in humans at high enough doses (Beyond Pesticides, 2001).

2.2.3.2 Lufenuron Physical and Chemical Properties and Toxicity

Lufenuron is a benzoylurea pesticide that is used to control insects like larval fleas. It has the molecular formula $C_{17}H_8C_{l2}F_8N_2O_3$ (see Figure 2.2), with a molecular weight of 511.2 g/mol. It has solubility in water (48 μg/l at 25°C) and partition coefficient (log P_{ow}=5.12), which means that it has the ability to bio accumulate in animal and human bodies. It needs more than 30 days to hydrolyze at pH 7 but 21.3 days at pH 9 (FAO, 2008). Agrochemical products which contain 50 g/l lufenuron are common insecticides that were used in agriculture such as match, which is a brand name for lufenourn insecticides products, which was found in plant samples in this study.

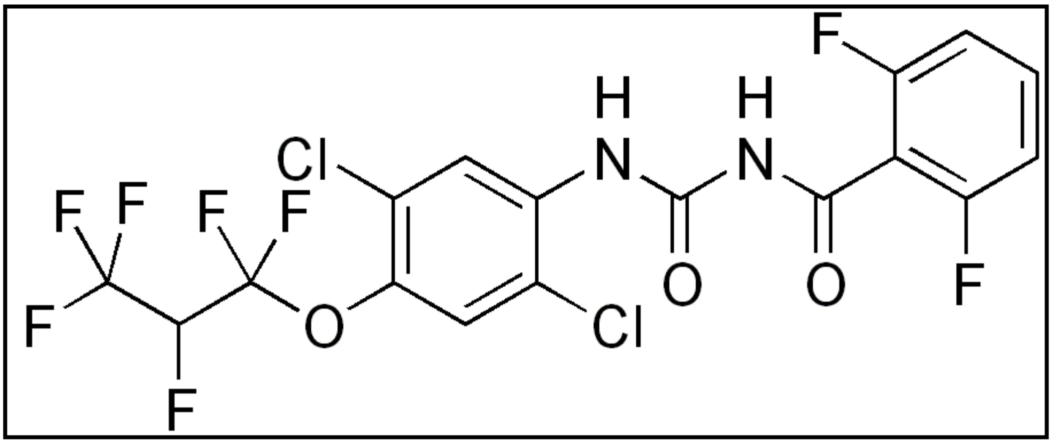


Figure (2.2): Structural formula of lufenuron

The WHO hazard classification of lufenuron is class III (slightly hazardous). Oral and dermal LD_{50} values in rats were estimated to be >2000 mg/kg bw for both sexes (FAO, 2008). The agreed acceptable daily intake (ADI) was 0.015 mg/kg bw/day based on the second 1-year dog study. During the acute toxicity testing, lufenuron showed skin sensitization properties. In oral short term studies with different species, clinical signs of neurotoxicity (tonic-clonic seizures or convulsions) and liver changes were observed, no mutagenic or carcinogenic potential was detected in the available studies (EFSA, 2008).

2.2.4 Pesticides Pollution in Environment

When the pesticides are applied on crops, not all of the pesticides reach to the target, so residues of pesticides are released to the environment.

Therefore, residues of pesticides contaminate soils and water, persist in crops, enter food chains, and finally are ingested by humans with foodstuffs and water. Furthermore, pesticides can be held responsible for contributing to biodiversity losses and deterioration of natural habitats (Peprah, 2001), (see Figure 2.3).

2.2.4.1 Pesticides in Water

The intensive application and misuses of pesticides can allow these chemicals to enter surface and ground water. Evaporation and wind erosion can carry them and then the return to surface water as rain and snow.

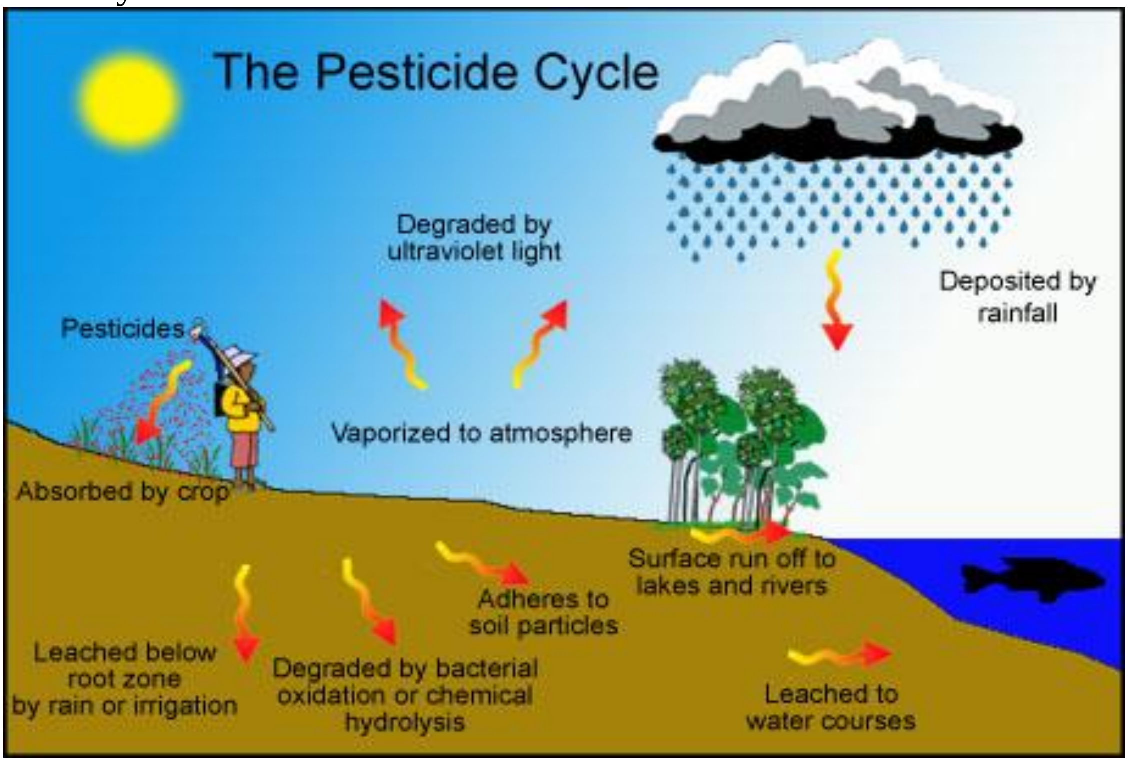


Figure (2.3): Routes of entry of pesticides into the atmosphere, surface and ground waters, soil and food

Besides that, soil can allow pesticides to leach to ground water. Surface water can be polluted by pesticides through run off of the irrigation water that carry these chemicals (Stevenson et al.). Herbicides are the most frequently found types of pesticides in streams and groundwater (US Geological Survey).

In general, groundwater has a lower incidence of pesticide contamination than streams because the water is filtered slowly through soil and rock, allowing for degradation and sorption of the chemicals out of the water and into the soil (Glase, 2006). It is noticed that surface water could re-clean contaminated water rapidly than ground water.

2.2.4.2 Pesticides in Soil

Pesticides may reach the soil through direct application to the soil surface, incorporation in the top of few inches of soil, or during application to crops (Akanet al., 2013).

Pesticides are strongly adsorbed to soils that are high in clay or organic matter. Most soil-bound pesticides are less likely to give off vapors or leach through the soil (Tiryaki et al, 2010). Pesticides in soil primarily break down through microbial and chemical (photolysis, hydrolysis, oxidation and reduction) degradation. Several factors affect chemical reaction such as warm temperature, soil pH, moisture but not saturated and aerobic soil conditions persist (Tharp, 2012). Pesticide residues in soil affect and damage microfauna and microflora, their toxic effects manifest on humans when bioaccumulation occurs along the food chain after initial plant uptake (Akan et al., 2013)

Abamectin residues were analyzed by Mohamed et al., (2012) in different fields in Egypt using HPLC. The results showed that the residual level of abamectin in soil cultivated by cucumber and tomatoes was 5.58 ppm while the levels of residue of abamectin in cucumber and tomatoes were 12.16 and 1.40 ppm, respectively.

In a study conducted in Palestine by (Ali, 2012), the soil from three different fields was analyzed to detect abamectin residues after 1, 5, 10 and 20 days of pesticides application, the results showed that the residue of abamectin was declining by time due to sunlight. It was degraded by the abamectin to many derivatives BHT, avermactin $B1_a$ and avermactin $B1_b$. It was noticed that the residue of abamectin on the twentieth day of spraying was less than the maximum residue levels.

2.2.4.3 Pesticides in Crops

Pesticides residues can reach to plant by the directly applied pesticides that may be still on crops after harvest. On the other hand, Plant roots adsorb pesticides residues in soil. The quantity of pesticides absorbed by a given plant generally depends upon the water solubility of the pesticide, the quantity of pesticide within the soil and the organic matter content of the soil. The total amount absorbed by a single plant increases with time if the residue is persistent (Akan et al., 2013).

Residues of pesticides in vegetables could affect human beings, especially when the vegetables are freshly consumed. The total dietary intake of pesticide residues that remain in crops are known as carcinogens and/or toxins (Zawiyah et al., 2007). Therefore, Government agencies and international organizations controlled the level of pesticides in food by establishing maximum residue limits (MRLs), with the aim of protecting consumers' health (Camino-Sa´nchez et al., 2010).

In a study conducted in Korea by Ming Xie et al., (2006). The researchers analyzed the abamectin residue in paprika by HPLC. The result showed that the total abamectin (AVM $B1_a$+ AVM $B1_{b)}$ residue was 18.40 mg/kg and the residue decreased with time, where the residues after 3, 5 and 7 of spray were 10.18, 8.07 and 7.59, respectively. The half time of degradation was 1.47 days for total abamectin in paprika.

Kamel et al., (2006) studied the degradation of the acaricides abamectin on Saudi Arabian date. It was noticed that the rate of abamectin residue decreased over the time, while the initial residue of abamectin on dates was 0.09 mg/kg and reached to 0.03 mg/kg after 7 days and 0.02 mg /kg after 14 days of application. The results showed that after 14 days, the b amount of residual abamectin was 0.02 mg/kg, it lied within the recommended minimum residue limit of 0.1 and 0.01 mg/kg set by WHO/FAO.

Ali, (2012) analyzed abamectin residues in tomato, cucumber and pepper in Palestine by High Performance Liquid Chromatography (HPLC) after 1, 5, 10 and 21 days day of spraying. The results for Pepper fruit, leaves and root showed that the residual levels were decreased gradually from 26.04, 26.82 and 23.38 mg /l, respectively to 0.0 mg/l. similar results were obtained for tomato and cucumber fruit, leaves and root. The results showed that the level of abamectin from the first day to the fifth day was higher than the maximum residue levels. It was noticed that there is rapid decrease of residue after the first day of application for three types of vegetables. For example, the residue after the first day for pepper fruit, leaves and roots were 26.04, 26.82 and 23.38 mg /l respectively, but at the fifth day the residue were 1.54, 5.77 and 1.17 mg/l respectively due to photo degradation and action of enzymes.

Hassan et al., (2013) studied degradation and residues of lufenuron in grape fruits in Egypt. The results showed that the initial deposit of lufenuron one hour after of spray was 1.85 mg/kg then the residue of lufenuron declined to 1.76 mg/ kg one day after. The residues decreased to 1.61 mg/ kg after two days application. The decrease in the residue of lufenuron continued after 7 and 10 days of treatment to be 0.695 and 0.23 mg/ kg-1 respectively. The calculated half-life value ($T_{1/2}$) for degradation of lufenuron on grape fruits was observed to be 2.79 days.

In a study conducted in Pakistan by Mirani et al., (2013) to investigate the effect of household processing in removal of lufenuron in tomato, residues were analyzed through HPLC. It was noticed that lufenuron of the highest lufenuron resides was in unwashed samples 1.75 ppm. The results showed that the plain washing with tap water reduced the lufenuron residues up to 29.71% and detergent washed unprocessed showed 48% reduction and residues becomes within MRLs 0.5 ppm. The lowest residual lufenuron was obtained at detergent washed fried tomato samples (0.06 ppm).

Parveen and Nakagoshi, (2001) conducted a field study in Bangladesh to evaluate the status of rice protection from pest and using pesticides by farmers. The results appeared that 30% of farmers used pesticides in the early tillering stage but the lowest number of farmer applied insecticides at the nursery stage. Among the survey, 48% of farmers said that the pesticide used to control pest was very effective and 8% of farmer said that the pesticide had small effect. In addition, the study showed that the largest portion of the farmer use crop rotation as an alternative to chemical pesticides, but 2% of the farmer use IPM method as an alternative to pesticides. Besides, farmers' knowledge was greatly influenced by their level of education. The results showed that the farmers did not have good perception for the impact of pesticides on the environment and most farmers believed that pesticides are the best way for pests control. In general, the average level of knowledge and perception of the respondents was found poor to moderate.

Ngowietal., (2007) studied the pesticides use practices, perceptions, cost and health effects by north Tanzania farmers, the results showed that most used types of pesticides were insecticides (59%) followed by fungicides (29%) and herbicides (10%) with the remaining 2% being rodenticides, More than 50% of the farmers spray pesticides up to 5 times or more per cropping season. About one third of the farmers mix two or more brands of pesticides. 53% of the farmers reported that pesticides usage was increasing in the past 5 years and they reported the reasons for increasing as being ineffective pesticides, pest resistance, increase in pest population and other reasons. Skin problems were the most poison effect for using pesticides followed by dizziness and headache.

In a study conducted in Gaza by Saleh and Esmaeel, (2002) field questionnaire has been prepared to characterize the knowledge, attitude of farmers about the use of pesticides, and how to deal with these pesticides in Horticulture. The results showed that 98% of farmers depend on chemical pesticides to control pests while half of the farmers collected and burnt infected crops as a method to fight pests. 67% of the farmers prefer to use the alternative methods before using pesticides. Most of the farmers reported that they preferred the biological control and natural ways as an alternative methods for using pesticides. In addition, 33% of the farmers are not familiar with and do not have knowledge about these alternative methods. Most of the farmers reviewed and followed instructions and safety precautions on label. The majority of farmers applied pesticides after the appearance of pest and few of them used it before. The study showed that most farmers did not receive special training in the safe use of pesticides. Most of them spray pesticide in great quantities. 83% of the farmers get rid of empty pesticides containers by burning or burial. 52% of the farmers believe that there are no incidents, poisoning and negative effects of misusing pesticides. Farmers suffer from problems regarding pesticides like high price pesticides, cheats in the quality and pesticides ineffectiveness.

In the West Bank, there is a study conducted by Zyoud et al., (2010) for assessing the knowledge and practices of pesticides use among farm workers. The results showed that (50.4%) of farmers prepared pesticides at the recommended concentration, while (22.8%) used more than the recommended concentration. (55.9%) of them mixed two or more pesticides. Most of the farmers wear special cloths and face masks. 71.1% of the farmers do not smoke during applying pesticides. In addition, 82.7% of the farmers wash their hands after spraying pesticides (82.7%), and

68.5% of them wash their contaminated clothes separately. 71.4% of the farmers always read the instructions on label. Most of the farmers stored pesticides on specific places. 60.9% of farmers used the remains of pesticides in the same day. The farmers suffered from toxicity symptoms due to using pesticides, the results showed that most symptoms reported by farmers were skin rash (37.5%), headache (37%), excessive sweating (24.9%), and diarrhea (21.3%).

2.3 Heavy Metals Pollution in Soil and Plant

Heavy metals in soil may either be found naturally or generated from anthropogenic activities. Natural sources include atmospheric emissions from volcanoes, transport of continental dusts, and weathering of metal-enriched rocks (Naveedullah et al., 2013). Anthropogenic inputs are associated with industrialization and agricultural activate deposition, such as atmospheric deposition, waste disposal, waste incineration, urban effluent, traffic emissions, fertilizer application and long-term application of wastewater in agricultural land (Qishlaqi and Moore , 2007).

Using wastewater in irrigation creates several pollution problems because it contains substantial amounts of toxic heavy metals. Excessive accumulation of heavy metals in agricultural soils through waste water irrigation may not only result in soil contamination, but also affect food quality because plant root may adsorb them (Arora et al., 2008) (Muchuweti et al., 2006). Several studies were carried out to study the effect of irrigation with wastewater on the accumulation of heavy metal in soil and plant.

Rattan, et al. (2005) characterized the impacts of long-term irrigation with sewage effluents on heavy metal content in soils, crops and groundwater. Soil samples, water samples from wells and 14 types of crops were collected from different villages in India where their crops have been irrigated with sewage effluents for 5,10 and 20 years. K, S, Zn, Cu, Fe, Mn, Ni, Pb and Cd were analyzed using inductively coupled plasma-atomic emission spectrophotometer (ICP-AES). The result indicated that the mean of heavy metal was higher in sewage samples than ground samples except Cd and Pb. There was no noticeable difference between their concentration in ground water samples and sewage. Due to long-term sewage irrigation, the pH of the soil dropped by 0.4 unit and organic carbon was increased by 59%. Sewage irrigation for 20 and 10 years resulted into significant build-up of DTPA- extractable Zn (208,113%), Fe (170,117%), Ni (63, 81%) in sewage-irrigated soils over adjacent tube well water irrigated soils, but Pb (29%) and Cu (170%) had only significant increase in soils receiving sewage irrigation for 20 years. Whereas Mn was depleted by 31% in soils that were irrigated for 20 years. Soil receiving sewage irrigation for 5 years had only significant increase in Fe accumulation.

Arora, et al. (2008) analyzed heavy metal accumulation in vegetables (radish, spinach, turnip, brinjal, cauliflower, lotus stem, mint, coriander, methi, and carrot) irrigated with water from different sources; samples were collected from agricultural fields irrigated with fresh water and wastewater. The results indicated that heavy metal concentrations in wastewater-irrigated vegetables were higher than fresh water irrigated crops. Heavy metals concentration order was Fe >Mn> Zn > Cu for all the crops except radish, turnip and carrot; for these the trend was Fe > Zn >Mn> Cu. The average mean of Fe concentration in mint and lotus stem were higher than other vegetables (378 and 335 mg/Kg, respectively), while the average mean levels of Mn had the highest concentration in Spinach (69.4 mg/Kg) but Carrot and Methi contained the highest mean concentrations of Zn (46.4 mg/Kg) and Cu (18.2 mg/Kg) respectively.

Pesticides were another source of heavy metals in arable soils from non-point source contamination. Although pesticides containing Cd, Hg and Pb had been prohibited in 2002, pesticides introduce copper and zinc to soil. The results for agricultural soil in China showed that a total input of 5000 tons of Cu and 1200 tons of Zn were applied as agrochemical products to agricultural land (Luo et al., 2009).

Phosphate fertilizers contribute to accumulate Cd and other heavy metals in soil. In a study conducted by Schippera et al., 2011 in New Zealand, the aim was to characterize and analyze the accumulation of cadmium and uranium in agricultural soil in New Zealand as result of intensive use of phosphate fertilizer in farming. 15–20 soil cores were collected to estimate total P, Cd and U for the start of the trial in 1983, and in 1988 at toe depth 0-70, 70-150 and 2006, for the 0–75 depth soil, on easy and steep slope classes at annual phosphate fertilizer loading rates of 0, 30, 50 and 100 kg P ha^{-1} yr^{-1}. The linear mixed models using the REML algorithm in GenStat was used to examine concentrations of total P, Cd and U and found relation between these concentration and P loading rate, year, slope class.

The result approved that there is relationship between total phosphate and increasing level of Cd, U in soil. There is linear relationship between increasing accumulation of U and increasing P-fertilizes load in both easy and steep slope, no significant change between two class of slope and U concentration change, the maximum concentration obtained was 2.80 mgUkg^{-1} on the 100 kg P ha^{-1} treatment.

For Cd, time trends in the further accumulation of Cd were well modeled by the broken stick form of the models with pre-1989 rates of increase higher than that post 1989. The rates of Cd depended on fertilizer P loading and slope class, with higher rates as P load increased, and for easy as opposed to steep classes (Schipperaet al., 2011). The maximum concentration of Cd obtained in the 100 kg P ha^{-1} yr^{-1} treatment which reached 0.931 mg Cd kg^{-1} on the easy slope.

Heavy metal toxicity has an inhibitory effect on plant growth, enzymatic activity, stoma function, photosynthesis activity and accumulation of other nutrient elements, and damages the root system (Onder et al., 2007).

Abou Auda et al. (2011) in Gaza studied the effect of heavy metals on soil in physiological parameters of spinach crops. It was found that when Cd was added on the soil, the length and weight of shoots and roots decreased. In addition, the result indicated that the concentrations of all of the plant pigments (chlorophyll a, chlorophyll b and total carotenoids) have significantly decreased with increasing Cd soil addition, but increased with increased Zn Soil addition.

Rattan, et al. (2005) found, in their study carried out in India, that in all crops the relative orders of transfer of metals from soil to crops - grown on sewage irrigated soils - were Ni > Zn > Fe >Mn> Cu. These results showed that as far as entry of these metals to food chain, crops are concerned. Based on the soil to plant transfer ratio (transfer factor) of metals, relative efficiency of some cereals, millet and vegetable crops to absorb metals from sewage and tube well water-irrigated soils was worked out (Abou Auda et al. 2011). The results suggested that there was not any proportional linear relationship between crops uptake of metals and increasing concentrations of metals in soils.

Sobukola et al., (2009) analyzed some heavy metals in sixteen fruits and leafy vegetables from selected markets in Lagos, Nigeria. The results showed that the levels of Pb, Cd, Cu, Zn, Co and Ni, ranged from 0.072-0.128, 0.003- 0.005, 0.002- 0.015, 0.039- 0.082, 0.014 - 0.026 and 0.070-0.137 mg/kg, respectively, for the fruits. While in leafy vegetables ranged from 0.09- 0.21, 0.03- 0.09, 0.02- 0.07, 0.01- 0.10, 0.02- 0.36 and 0.05-0.24 mg/kg respectively. The result showed that levels of cadmium and copper were observed to be the lowest for the samples while the levels of nickel and lead were the highest. The same was order reported by Naser et al., (2011) where the order of heavy metal levels in different vegetables was Cd<Co<Pb<Ni<Cr.

The studies indicated that the capacity of the plant to uptake and accumulate heavy metals varies by plant species. Naser et al., (2011) studied the levels of heavy metals in three different crops spinach, red amaranth and amaranth in Bangladesh. The results observed that the maximum concentration of Cd, Ni, and Cr were recorded in spinach but the maximum concentration were found in Pb and Co in amaranth.

Abulude, (2005) measured the accumulation of some trace metals (Fe, Cr, Zn, Pb) in soils and vegetables in the vicinity of a livestock in Nigeria. Soil samples at depth 0- 10 and 10- 20 cm and 12 vegetable samples were collected from 4 site near livestock farms (cattle, piggery, sheep and goat and poultry sections). The soil results showed that the mean heavy metal contents in sheep and goats and piggery sections were lower than cattle and poultry sections, the concentration of Zn and Fe were higher than Cr and Pb in all samples while the vegetables samples indicated that heavy metals can enter food chain by plant uptake. The statistical analysis of the database in the study for the correlation coefficient values of trace metal concentrations distributed between the vegetables and the soil depths found that at depth 0-10 cm Zn and Cr were easily adsorb but Fe and Pb were easily to adsorb at 10-20 cm.

Toxicity of heavy metals

Crops grown in polluted environment can accumulate heavy metals at high concentration causing serious risk to human health when consumed. Moreover, heavy metals are toxic because they tend to bio accumulate in crops and animals, bio concentrate in the food chain and attack specific organs in the body (Naser et al. ,2011). Following the health effect of accumulation of some of heavy metals at high level on the body.

Pb: Lead poising can cause poor muscle coordination, nerve damage to the sense organs and nerves controlling the body, increased blood pressure, hearing and vision impairment and reproductive problems (e.g., decreased sperm count). Pb can cause behavioral problems and anemia for children (EPA).

Cd: Bone fracture, diarrhea, stomach pains and severe vomiting, reproductive failure, damage of central nervous system and DNA, in addition to cancer development (Oti Wilberforce and Nwabueet, 2013).

Zn: Stomach cramps, nausea, and vomiting. Ingesting high levels of zinc for several months may cause anemia, damage the pancreas, and decrease levels of high-density lipoprotein (HDL) cholesterol (ATSDR, 2005)**.**

Cu: Cramps of legs or spasm, colicky abdominal pain, attention deficit disorder, arthritis, asthma, autism, candida overgrowth, depression, male infertility, prostatitis, fibromyalgia, migraine headaches, PMS, chronic infections, insomnia, and coma precede death (Ashish et al., 2013)**.**

Fe: Depression, rapid and shallow respiration, coma, convulsions, respiratory failure, and cardiac arrest. The studies on animals suggested that Fe can be carcinogenic to animals (WHO, 2003)**.**

Ni: Stomach cramps, nausea, and vomiting may occur. Ingesting high levels of zinc for several months may cause anemia, damage the pancreas, and decrease levels of high-density lipoprotein (HDL) cholesterol (ATSDR, 2005)**.**

2.4 Summary

Agricultural practices can introduce several pollutants to environment. Fertilizers are one of these chemical that effect the environment. The excessive use of chemical and natural fertilizers can lead to the satisfaction of soil by nutrients such as phosphate and nitrate. This leads to the movement of nutrients to ground water. Accumulation of fertilizers in the soil can change its properties, such as increasing its acidity and salinity, reducing the amount of water that the crops absorb and decreasing the productivity. Crops can absorb nutrients from the soil by roots and accumulate them in plant parts. When the levels of nitrate and phosphate exceed the allowable limit in plant and water, consumer toxicity can occur.

Although pesticides can help farmers to kill insects and increase crop yields, the excessive and improper usage of pesticides can cause several adverse impacts on environment and humans**.** Theses chemical can be adsorbed on organic matter of soil and accumulated in soil. Pesticides in agricultural soil have effects on both the biotic and abiotic processes within the soil (Zalidis et al., 2002). Pesticides residues in soil can damage the physical and chemical properties of the soil and reduce its fertility. Some of the pesticides are soluble in water, so can mobilize to ground water. In addition run off of the water may get contaminated by pesticides leading to surface water pollution. Pesticides have the potential to transfer and accumulate on vegetables causing several adverse health effects on humans and animals consuming them. Therefore, several intentional organizations have established maximum allowable residue limits of pesticides.

Long-term application of fertilizers, manure, pesticides and wastewater in irrigation can lead to heavy metals accumulation in soil, besides that Crops and vegetables grown in soils polluted with heavy metals have potential to accumulate heavy metals on their edible and non-edible parts. These metals have the ability to leach into groundwater, because most heavy metals are soluble in water, causing groundwater pollution.

Heavy metals have special characteristics that make them very harmful. Some of these characteristics are that they are non –biodegradable, persistent in nature and have the ability to accumulate in human and animals body causing toxicity and several dangerous diseases when threshold is exceeded.

There is excessive use of agricultural land in Al-Far'a catchment including agricultural water use without proper lands and water management. Besides that, agriculture is one of the oldest activities in the catchment that caused accumulation of agriculture- produced pollutants in soil and water. There is lack of proper previous - comprehensive studies conducted on the subject matter and accordingly, in this study the effects of the agricultural activities in soil, water, and crops in Al-Far'a catchment will be investigated and characterized.

Chapter Three
Methodology

3.1 Experimental Program

The experimental part of this research focuses on studying and evaluating the impacts of the agricultural practices on soil and ground water in Al-Far'a catchment. Water samples were collected from 33 different agricultural wells, several analyses of nitrate, phosphate, hardness, biological oxygen demand (BOD), chemical oxygen demand (COD), pH, electrical conductivity and total dissolved solids (TDS) were conducted on the water samples to assess the impact of intensive agricultural practices on ground water wells. Soil and crops samples (fruit, leaves and shoots) were collected from different areas to evaluate pollutants accumulation resulting from agricultural practices. Analysis of nitrate, phosphate, heavy metals and pesticides residue (abamectin and lufenuron) were conducted on the gathered samples.

The survey part of this research was conducted to investigate and characterize the agricultural activities practiced by farmers in the study area. Field questionnaire was prepared and distrusted on Al-Far'a farmers.

3.2 Sampling

3.2.1 Water Sampling

Water samples were collected from 33 different agricultural wells out of the 62 wells located in Al-Far'a catchment. The samples taken were from 19 wells in Ras Al-Far'a, 9 wells in Wadi Al-Far'a, 4 wells in An-Nassariyya and one in Al-Jiftlik. Water samples were collected in clean polyethylene bottles which had been previously rinsed with HCl, followed with distilled water. Samples were collected after wells had been pumping for a considerable period of time, and the volume of each sample was 1 L. Samples were kept refrigerated until analyzed.

3.2.2 Soil sampling

Soil samples were collected from three different planted fields in the catchment (Ras Al-Far'a, Wadi Al-Far'a and Sahal Smeet). Aubergine was planted in Ras Al-Far'a and cucumber was planted in Wadi Al-Far'a and Sahal Smeet. Samples were taken from three depths; 0–20 cm for topsoil, 20–50 cm for the middle horizon and 50-100 cm. Samples were placed in plastic bags and sealed for transport and storage. After that, the samples were air-dried and sieved with 2 mm stainless steel sieving. Then the samples were stored in the refrigerator at 2-4 C° in order to be analyzed.

For pesticides analysis, 100 g soil samples were collected after 5 days from pesticides application from two different planted fields in the catchment at three depths (0-20, 20-50 and 50-100 cm) to analyze pesticides residues. Lufeuron residues were analyzed in soil samples that were collected from a field treated with match pesticides, and abamectin residues were analyzed in soil samples that were collected from a field treated with vertamic pesticides. Other samples were collected, treated and stored exactly as described in the previous method.

3.2.3 Crops Sampling

Two crops were harvested from near the points where soils were taken in the tow locations, aubergines crops were harvested in Ras Al-Far'a and cucumber in Wadi Al-Far'a. The crops were taken to the laboratory immediately. They were separated into four parts (stem, leaf, fruit and peel). The crops were then air - dried and treated for analysis.

For pesticides analysis, green bean fruits were also collected from a field sprayed by lufenuron pesticide, and aubergin were collected from a field sprayed by abamectin pesticide, then the samples were stored in the refrigerator at 2– 4 C° in order to be analyzed. The plant samples were collected for pesticide analysis after five days from spraying pesticides. Soil and plant samples were taken from the same fields.

3.3 Laboratory Analysis:

3.3.1 Water Analysis Methods

In order to assess the impacts of intensive agricultural practices on ground water, several chemical parameters were chosen to analyze the collected water samples and they are:

3.3.1.1 Biochemical Oxygen Demand (BOD)

Airtight bottle was filled by 250 ml water and incubated at 20˚C for 5 days. After 5 days, Biochemical dissolved oxygen reading (ppm) was measured by using the dissolved oxygen test kit (Clescerl, L. S et al., 1998).

3.3.1.2 Chemical Oxygen Demand (COD)

Chemical Oxygen Demand (COD) was determined by digesting water sample with Potassium Dichromate and concentrated Sulfuric acid, and after that sample was titrated with 0.05 M potassium dichromate (Clescerl, L. S et al., 1998)

3.3.1.3 Nitrate

Nitrate was determined by using HANNA® meter nitrate HI 93728.

3.3.1.4 Phosphate

Phosphate was determined colorimetry by using combined ascorbic reagent. Combined ascorbic reagent was containing Ammonium molybdate, antimony potassium tartrate, sulfuric acid and ascorbic solution. This combined reagent was added to water sample and blue color was formed, absorbance of blue color was measured by spectrophotometer at wavelength 720(Clescerl, L. S et al., 1998).

Phosphate calibration curve

Table (3.1): Absorbance readings of phosphate standards

Concentration (ppm)	Absorbance
0.4	0.096
0.6	0.146
0.8	0.196
1.0	0.236
2	0.5
3	0.686
4	0.918
6	1.365
8	1.761

Stock phosphorus standard solution was prepared from Potassium Phosphate monobasic (KH_2PO_4), nine standard phosphorus concentrations were prepared from stock solution and treated as same as the samples. These nine concentrations were used to plot absorbance versus phosphate concentration to give a straight line, and they were 0.4, 0.6, 0.8, 1.0, 2.0, 3.0, 4.0, 6.0, and 8.0 ppm. Table (3.1) shows each standard concentration and absorbance readings while Figure (3.1) shows the calibration curve of phosphate.

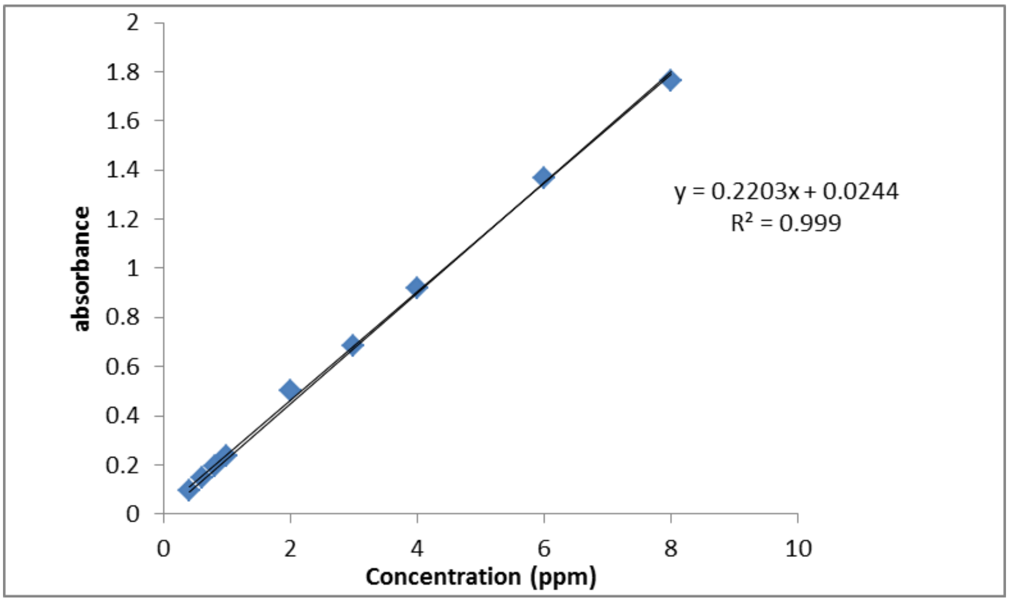


Figure (3.1): Calibration curve of phosphate

3.3.1.5 Total hardness

Hardness was determined by titrated sample against disodium ethylene diamine tetra acetate (EDTA) to its equivalence point by using Eriochrome Black T which color change from red to blue. After titration, pH of the sample was adjusted to 10.0 with an ammonium buffer (Clescerl, L. S et al., 1998)

3.3.1.6 pH, Total Dissolve Solids and Conductivity

Electrical conductivity, total dissolved solids (TDS) were measured by using (HACH® Sension 156) Conductometer and pH was measured using HANNA® meter HI 8424.

3.3.1.7 GIS Mapping

Spatial analysis of chemical water data was performed by using the basic geodatabase creation function of ArcGIS 10 software, the Inverse Distance Weighted (IDW) method was chosen for spatial interpolation of water parameters. GIS application was conducted according to (Shomar et al., 2010) and (Nikolaidis. P et al, .2007) with some modifications.

In this study, spatial data were obtained from Al-Far'a well map and Al-Far'a outline map.

3.3.2 Soil Analysis Methods:

3.3.2.1 Phosphate

For phosphate measurements, soil sample was digested by perchloric acid then the sample was diluted by distilled water to 250 ml. Then 10 ml of the solution were diluted to 50 ml. After that, phosphate was determined colorimetry by using combined ascorbic reagent. Combined ascorbic reagent contains Ammonium molybdate, antimony potassium tartrate, sulfuric acid and ascorbic solution. This combined reagent was added to a water sample and blue color was formed, absorbance of blue color was measured by spectrophotometer at wavelength (410) (Manual laboratory analysis for soil and crops, Jon Rayen, et al., 2003)

Phosphate calibration curve was the same as the curve in phosphate water test (3.3.1.4)

3.3.2.2 Nitrate

- **Extraction methods**

25.0 ml of 2.0 M KCl was added to 5.0 g of air dried sample, then the mixture was placed on centrifuges for 30 minutes. Then the extract was filtered (Miller and Sonon). NO_3^- content of the extract was determined using spectrophotometer

- **Spectrophotometer Analysis**

Szechrome NAS reagent (Diphenylamine sulfonic acid chromcgene) was dissolved in a mixture of sulfuric acid and phosphoric acid, after that reagent was added to the extract, a violet color was developed and read at

570 nm (Szechrom-NAS reagent, R&D Authority, Ben-Gurion University of the Negev, Beer-Sheva)

- **Nitrate Calibration Curve**

Stock nitrate standard solution was prepared from potassium nitrate. Standard nitrate concentrations were prepared from stock solution and treated as same as the samples. 0.2, 0.4, 0.6, 0.8, 1, 2 and 3 ppm concentrations were used to plot absorbance versus nitrate concentration to give a straight-line. Table (3.2) shows that each standard concentration and absorbance reading. While Figure (3.2) shows the calibration curve of nitrate.

Table (3.2): Absorbance readings of nitrate standards

Concentration (ppm)	Absorbance
0.2	0.01
0.4	0.03
0.6	0.05
0.8	0.062
1.0	0.085
2.0	0.168
3.0	0.236

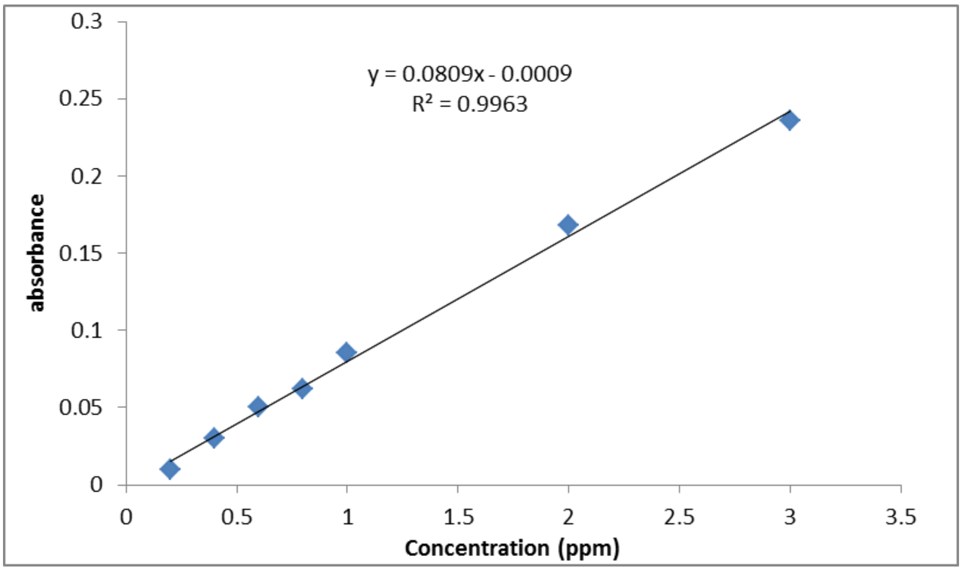


Figure (3.2): Calibration curve of nitrate

3.3.2.3 Heavy Metals

Sample was dried at 110˚C, then 0.5 g of the dried sample and 5 ml of concentrated HNO_3 was added to 50 ml folin digestion tube. The mixture was heated to 120-130˚ C for 14-16 hours, then was treated with hydrogen peroxides, after digestion the sample was diluted and analyzed by Inductivity Coupled Plasma Mass Spectrometry ICP-MS (University of Wisconsin, 2005)

3.3.3 Corps Analysis Methods

3.3.3.1 Phosphate

Sample was ignited for 5 hours at 550˚C, then ash was dissolved in 2.0 N HCl, volume was completed to 50.0 ml by distilled water after 30 minutes solution was filtered. Combined ascorbic reagent was added to 5 ml of solution, developed blue color was read at (410) nm (Manual laboratory analysis for soil and crops, Rayen, et al., 2003).

Phosphate calibration curve was the same as the curve in phosphate water test (3.3.1.4)

3.3.3.2 Nitrogen

Dried crop sample was digested by H_2SO_4 and hydrogen peroxide until the sample was cleared, then nitrate content was measured by distillation method. NaOH was added to the sample, then the sample was distilled. After that distilled sample was titrated against 0.01 H_2SO_4 to PH5.0 (Manual laboratory analysis for soil and plant, Rayen et al,. 2003).

3.3.3.3 Heavy Metals:

Sample was dried at 110˚ C, and then 0.5 g of the dried sample and 5 ml of concentrated HNO_3 were added to 50 ml folin digestion tube. The mixture was heated to 120-130˚ C for 14-16 hours, then was treated with hydrogen peroxides after that the digestion sample was diluted and analyzed by Inductivity Coupled Plasma Mass Spectrometry ICP-MS (University of Wisconsin, 2005)

3.3.4 Pesticides Analysis

3.3.4.1 Abamectin Analysis

3.3.4.1.1 Extraction Procedure

Fifty-gram samples of fruits were blended for 3 minutes with 50 ml of acetone and 100 ml ethyl acetate. The solution was filtered through Buchner Funnel. Finally, the solution was evaporated to dryness on water bath (70 C°), then the residues were diluted with 2 ml of ethyl acetate and transferred into a 100 ml vial stored at -30 C° until analysis by HPLC (Ali, 2012)

3.3.4.1.2 Analysis procedure

- Samples and Standard preparation:

- Standard preparation: 2 ml was taken from abamectin standard and diluted to 100 ml by ethanol.
- Sample perpetration: Residue solution from extraction was diluted to 50 ml by ethyl acetate, then 1 ml pipette from the residues solution and 0.5 ml from standard solution were diluted to 25 ml by methanol.

- HPLC analysis

To analysis abamectin high performance liquid chromatography (HPLC) was used with UV detector, C8 Colum (100x4.6mm,20 µm). The wavelength was 215 nm. Mobile phase solution was prepared from methanol and distilled water (80:20 v/v), and the flow-rate used was 0.4 ml/min. Then samples and standards were injected at equal volume (20µ liters) of standard solution into HPLC. The chromatograms observed that the average retention time for abamectin standard and residue in samples was 11.7±0.2 min

3.3.4.2 Lufenuron Analysis

3.3.4.2.1 Extraction Procedure

30 ml acetone was added in 25 g of sample and 20 g of sodium sulfate and homogenized in blender for 10 minutes. The homogenate was filtered twice with Whatman No.1 filter paper. The filtrate was dried on water bath (70 C°) 2 ml acetonitrile was added in dried filtratel then transferred into a 100 ml vial stored at -30 C° until analysis by HPLC (Benish Nawaz Mirani et al., 2013).

- Samples and Standard preparation:

- Standard preparation: 1 ml was taken from lufenuron standard and diluted to 100 ml by ethanol.
- Sample perpetration: 1 ml standard solution was added to residue samples then solutions were diluted to 50 ml by acetonitrile.

- HPLC analysis

To analysis lufenuron high performance liquid chromatography (HPLC) was used with UV detector, C8 Colum (100x4.6 mm, 20 µm). The wavelength was 245 nm. Mobile phase solution was prepared from methanol and distilled water (80:20 v/v), and the flow-rate used was 0.5

ml/min. Then samples and standard were injected at equal volume (20µ liters) of standard solution into HPLC.

The chromatograms observed that the average retention time for lufenuron standard and residue in samples was 8.16±0.07 min

3.4 Field Questionnaire

The main objectives of the field questionnaire were:

- to investigate the knowledge and practices associated with agrochemicals use.
- to evaluate farmers practices regarding the storage, preparation and disposal agrochemicals.
- to identify self-reported toxicity symptoms associated with pesticides.
- to assess farmers perception about the effect of agrochemicals on the environment.
- and to characterize the different irrigation practices used.

Therefore, field questionnaire was devolved to be filled by farmers after an interview. The target group was farmers form four areas in Al-Far'a catchment: Ras Al-Far'a, Wadi Al-Far'a, An-Nassariyya and Al-Jiftlik

The questionnaire is divided into four main sections and a general section. The general section included social questions (age, gender and education) and farming questions (farm size and factors which farmers was interested in when they planted crops).

The first section contains questions that measured knowledge and experience of farmers about pesticides and fertilizers usage, such as how long have they been using pesticides and fertilizers, person who sprayed agrochemicals, mixing different pesticides brands before application, preparing concentration of pesticides and fertilizers, farmers who have received any formal training for pesticides and fertilizers usage and other questions.

The second section included question that aims to evaluate the protective measures used by farmers and to assess their practices before and during applying pesticides (such as wearing protective cloths, changing cloths, taking shower after application, observing wind direction and time of rain, eating smoking during spraying, types of sprayers, agrochemical bottles storage, disposal of empty pesticides bottles, pre-harvest interval of pesticides, method of pesticides spraying and other questions).

The third section contained questions related to the health effects resulting from the exposure to pesticides (symptoms associated with pesticides use). There were also questions that measured the level of perception of the respondent farmers towards the impact of the pesticides and fertilizers on the environment (such as pesticides impacts on soil, water and air and accumulation of pesticides and fertilizers in crops). Besides that, there were questions that measured the farmers attitude toward the using alternative methods other than pesticides.

The fourth section contained questions that assess the knowledge and practices of farmers associated with irrigation, for examples: method of irrigation, sources of water for irrigation, times of irrigation in summer and winter, irrigations problems regarding water facing them in Al-Far'a catchment, usage of wastewater in irrigation, irrigation net works and other questions.

Farmers filled the field questionnaire after an interview- see appendix (B). A total of (155) farmer filled the field questionnaire, this sample size is between 1% to 5% of the about total number of farmers in the catchment (1212 farmers). The field questionnaire was based on United States Environmental Protection Agency questions, and on that used in similar studies with some modification and (Vietnam: Pesticide Use Survey) (El-Zanaty& Associates. 2001).

Statistical analysis was performed using statistical package for social science (SPSS) version 20. Descriptive results were expressed as frequencies, and percentages for categorical variables, the χ^2, ANOVA, and the correlations in the test were used to test the significance of differences between categorical variables, P values of less than 0.05 were accepted as statistically significant.

Chapter Four
Results and Discussion

4.1 Chemical Analysis Results

4.1.1 Water Results

Table (4.1) shows the results of the chemical analysis representing concentration of nitrates NO_3^-, phosphate PO_4^{-3}, BOD, COD, TDS, pH, EC, and hardness in the 33 agricultural wells samples.

4.1.1.1 Nitrate Results

The mean nitrate concentration of all samples was 19.9 ppm, Nitrate concentrations in the samples ranged from 4.43 to 58.0 ppm. While the highest concentration of nitrate was found in a well in Ras Al-Far'a 58.0 ppm, the lowest concentration was also found in a well located in Ras Al-Far'a 4.43 ppm. Figure (4.1) is a GIS map that indicates the spatial distribution of nitrates NO_3^- in Al-Far'a catchment. The concentration 58.0 ppm exceeded the WHO standards of drinking water (50 mg/L) for nitrate (as NO_3^-). The guideline values are established to protect young infants from methaemoglobin formation. However, the guideline advises that water with a nitrate concentration of up to 100 mg-nitrate/L can be used by adults and children over 3 months of age without risk of significant health effects (WHO. 2011). Nitrate values in all the water samples were found to be within the permissible limits for irrigation water standards (Table 4.1) . The risk of NO_3^- leaching is particularly high after the harvest, when plant uptake is low (Charkhabi et al., 2006) so excess nitrate do not adsorb on soil and can be transported to ground water.

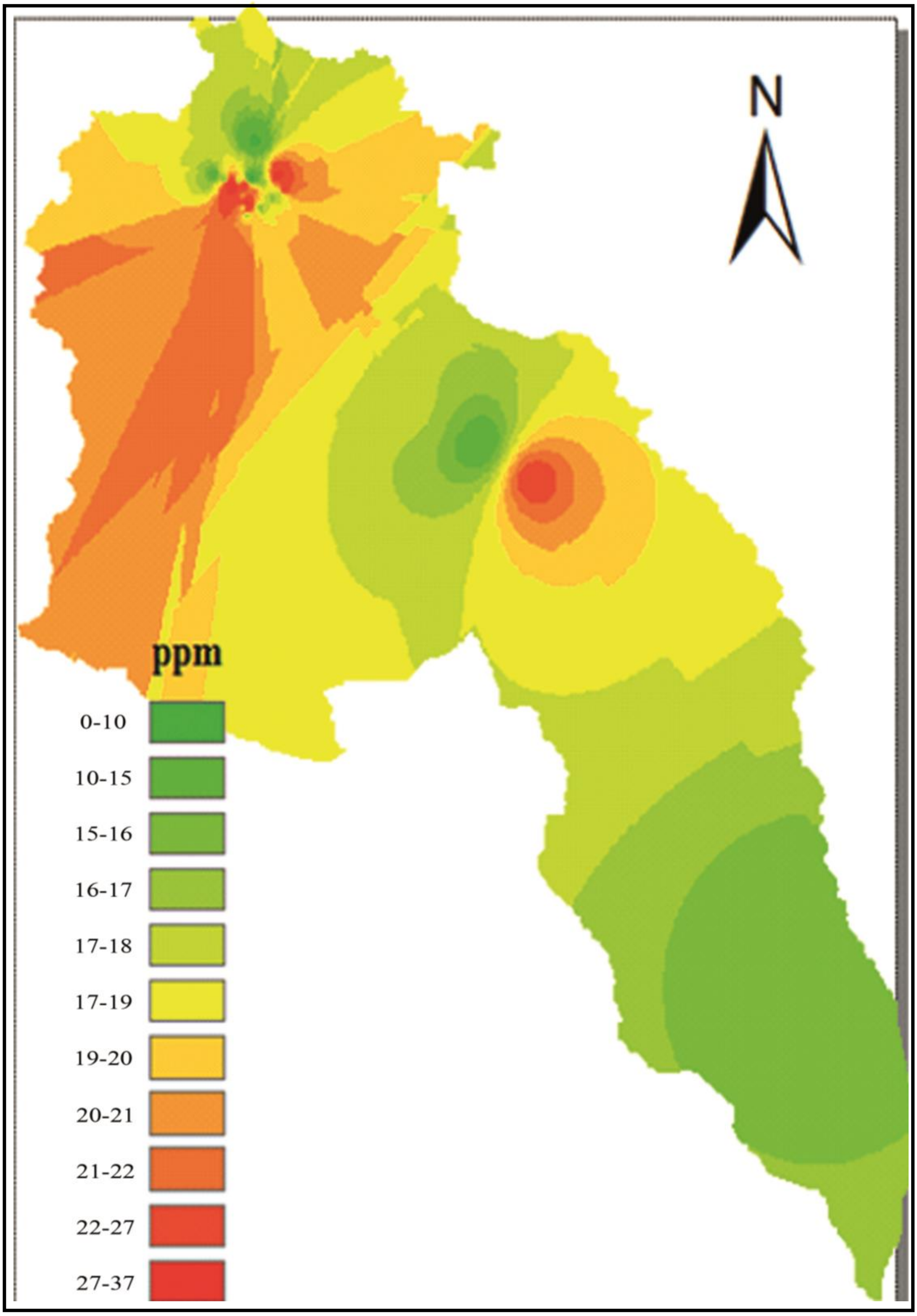


Figure (4.1): GIS map indicating the spatial distribution of nitrates NO_3^- in Al-Far'a catchment**.**

Table (4.1): Results of the chemical analysis representing concentration of nitrates NO_3^-(ppm), phosphate PO_4^{-3}(ppm), BOD, COD (ppm), TDS (ppm), pH, EC(μs/cm), and hardness (mg $CaCO_3$/L) in the 33 agricultural wells in Al-Far'a catchment

Well	NO_3^-	PO_4^{-3}	COD	BOD	TDS	pH	EC	Hardness
Ras Al-Far'a								
1	37.29	0.0	16	5	234	7.85	444	290
2	16.39	0.08	208	15	297	7.65	453	200
3	16.39	0.0	20	10	401	7.57	456	320
4	31.01	0.02	40	0	428	7.42	930	510
5	17.28	0.0	40	0	307	7.24	573	330
6	18.61	0.0	16	0	322	7.43	669	400
7	17.28	0.03	32	0	344	7.95	688	260
8	23.92	0.0	16	0	355	6.93	751	350
9	16.83	0.0	28	17	302	7.83	464	330
10	8.42	0.0	40	12	298	7.64	511	370
11	23.48	0.18	24	6	331	7.3	749	430
12	4.43	0.0	30	17	290	7.8	510	360
13	34.55	0.0	8	5	287	7.69	590	470
14	18.16	0.0	16	0	298	7.42	597	370
15	19.05	5.41	48	14	342	7.73	721	370
16	58.03	0.04	16	10	419	7.74	729	480
17	16.83	0.0	45	25	402	7.53	676	470
18	20.39	0.29	16	0	341	7.62	720	310
19	26.14	0.02	24	15	314	7.5	523	400
Wadi Al-Far'a								
20	14.62	0.0	56	45	414	7.86	827	370
21	16.39	0.02	104	37	293	7.44	587	380
22	23.48	0.0	48	45	390	7.32	583	420
23	21.71	0.0	56	48	342	7.73	684	290
24	15.95	0.0	40	39	287	7.41	573	290
25	16.39	0.0	32	15	252	7.6	504	370
26	12.85	0.0	72	20	298	7.55	594	410
27	19.49	0.0	64	40	305	7.33	611	410
28	14.62	0.0	80	37	209	7.34	422	350
An- Nassariyya								
29	13.29	0.08	40	5	685	7.27	345	400
30	15.95	0.03	67	24	577	7.43	289	340
31	15.51	0.26	60	48	748	7.33	377	540
32	17.72	0.57	50	20	820	7.38	405	440
Al-Jiftlik								
33	14.6	0.1	56	30	695	7.32	350	350
Guidelines of irrigation water quality	15NO_3-*N (66 NO_3)	2 PO_4-p**	90*	30*	2000**	5.0-9.0*	3000**	---

References:* MESD, 1999 **FAO

4.1.1.2 Phosphate Results

The mean phosphate concentration in samples was 0.22 ppm. The results showed that phosphate was not detected in any level in most Wadi Al-Far'a wells. The highest level of phosphate was found in a well located in Ras Al-Far'a where the level of phosphate was 5.41 ppm (Table 4.1). It was the only value that exceeded the maximum permitted concentration based on EC standards for drinking water (5ppm) (Nikolaidis et al, .2007) and the FAO standards for irrigation water quality (Table 4.1). This value came from the improper management of phosphorus fertilizers application. phosphate ion does not leach from soil to ground water as nitrate ion because it has less solubility than nitrate in water and it accumulates in top soil. Figure (4.2) indicted the spatial distribution of phosphate in Al-Far'a catchment.

4.1.1.3 EC Results

Table (4.1) shows that the lowest EC value was 289 µS/cm and the highest was about 930 µS/cm. Water with more EC is more salty. The EC values in the water samples were found to be within the permissible limits of the WHO Standards for drinking water (2500 µS/cm) (Divya and Belagali 2012) and the FAO guidelines for irrigation water quality (Table 4.1). Figure (4.3) shows the spatial distribution of EC in Al-Far'a catchment.

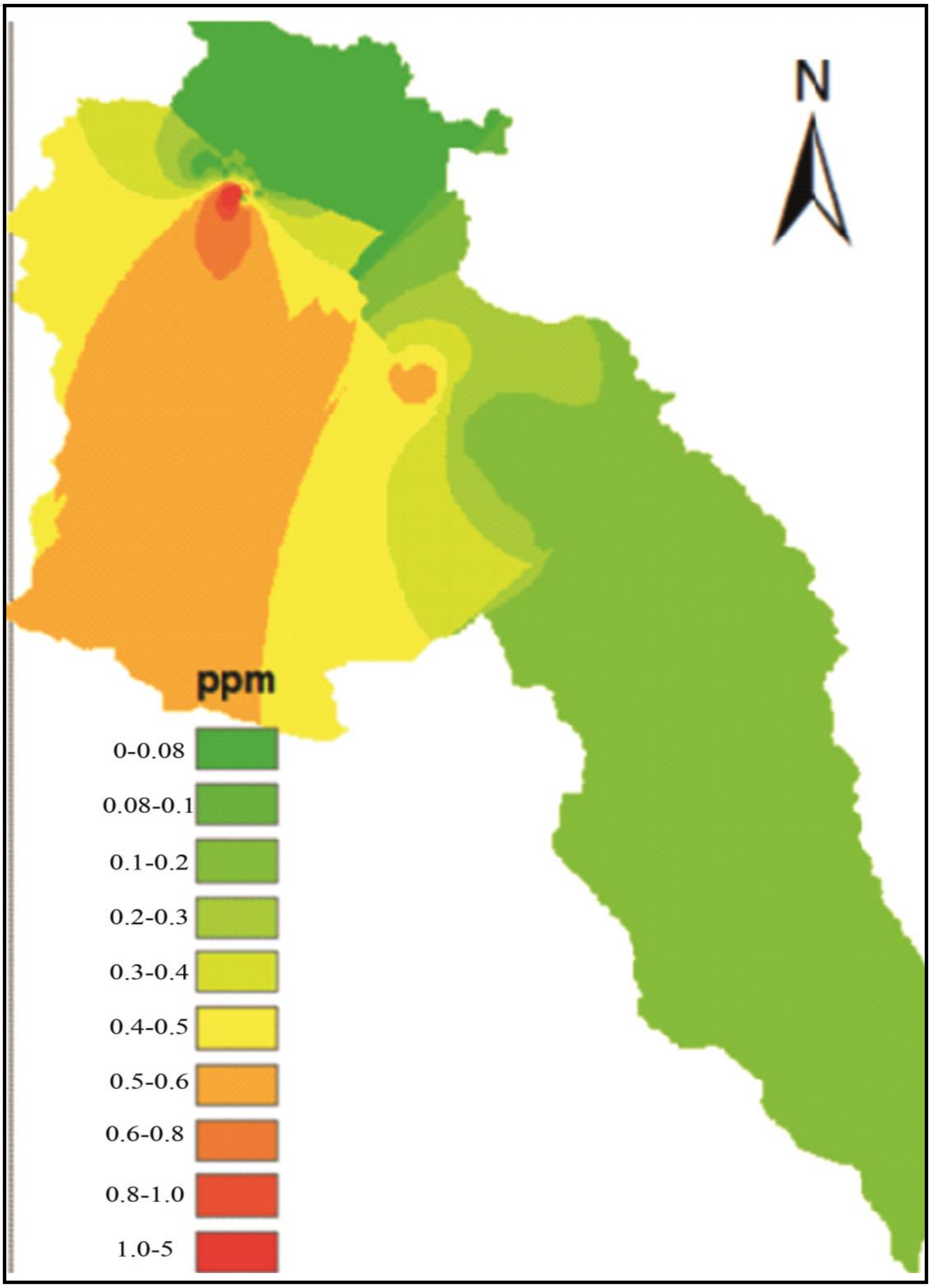
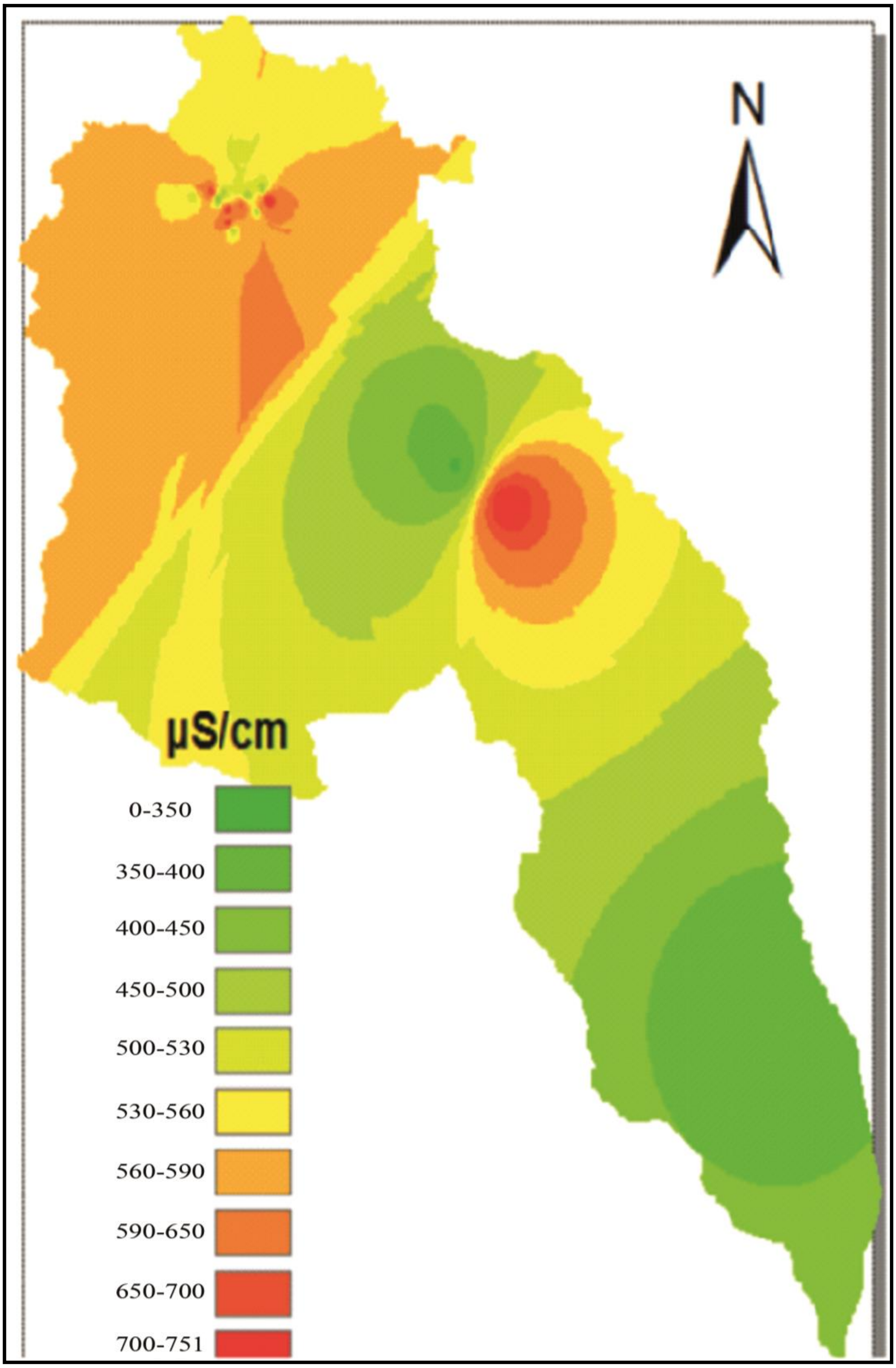


Figure (4.2): GIS map indicating the spatial distribution of phosphate in Far'a catchment.

Figure (4.3): GIS map indicating the spatial distribution of EC in Al-Far'a catchment



4.1.1.4 BOD and COD Results

The mean COD concentration of samples was 45.7 ppm, while the mean BOD concentration of samples was 18.3 ppm. The lowest concentration of COD was found in a well located in Ras Al-Far’a 8.0 ppm. The highest COD was obtained in a well also located in Ras Al-Far’a 208 ppm. COD conveys the amount of dissolved oxidisable organic matter including the non-biodegradable matters present in it. The minimum values of COD in different water samples indicate low organic pollutants, while maximum concentration indicates higher concentration of pollutants (Divya and Belagali, 2012). The results showed that two out of thirty three wells contained COD level higher than the maximum allowed concentration for irrigation water quality (MESD, 1999) (Table 1.4).

For BOD, the highest levels were found in two wells located in Wadi Al-Far’a and Al-Jiftlik 48.8 ppm, but 7 out of 33 wells did not obtain any BOD level and these wells where located in Ras Al-Far’a. Eight out of thirty-three wells contained BOD levels higher than maximum allowed concentration for irrigation water quality (MESD, 1999) (Table 1.4).

Figures (4.4) and (4.5) show that spatial distribution of COD and BOD in Al-Far’a catchment, respectively.

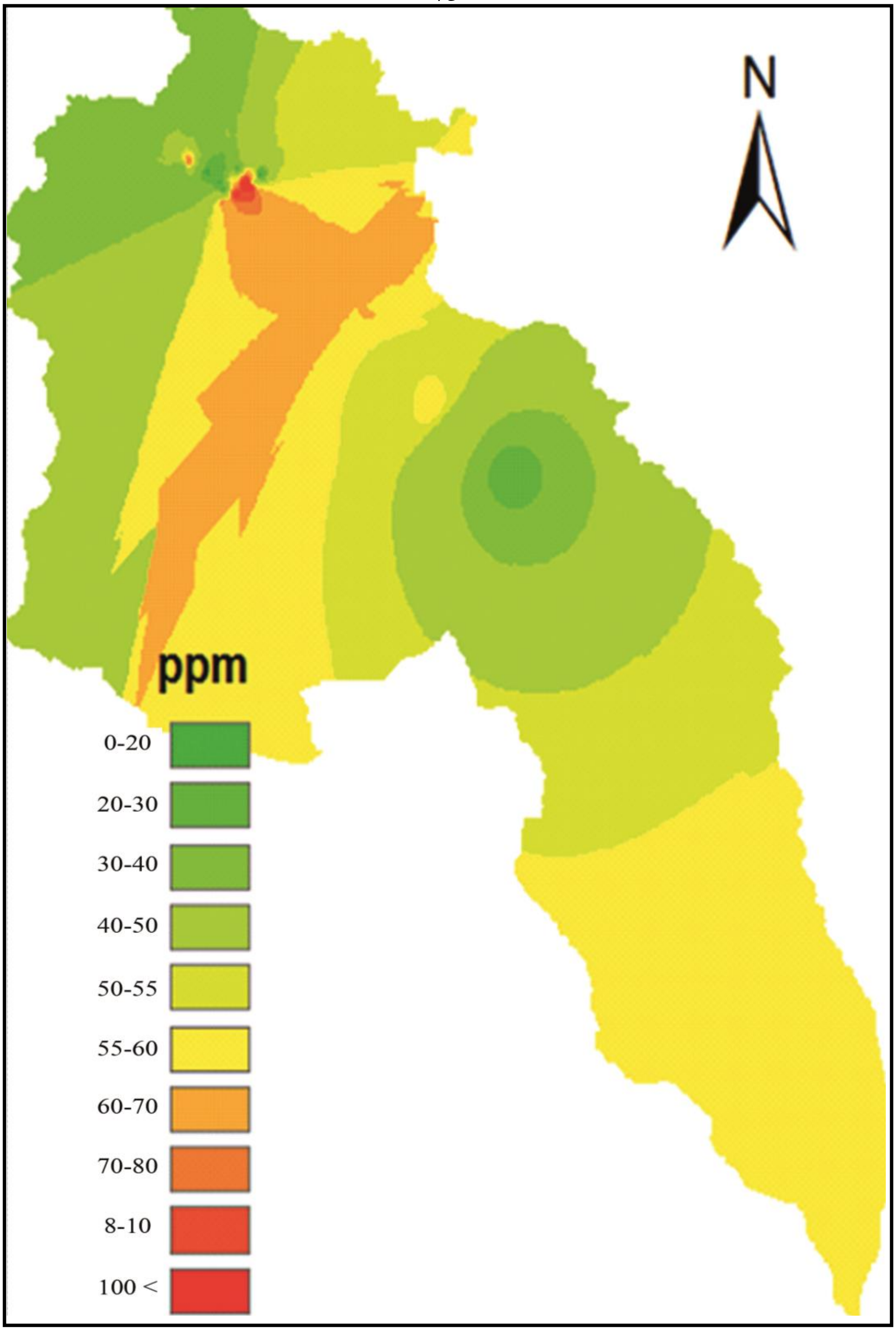


Figure (4.4): GIS map indicating the spatial distribution of COD in Al-Far'a catchment.

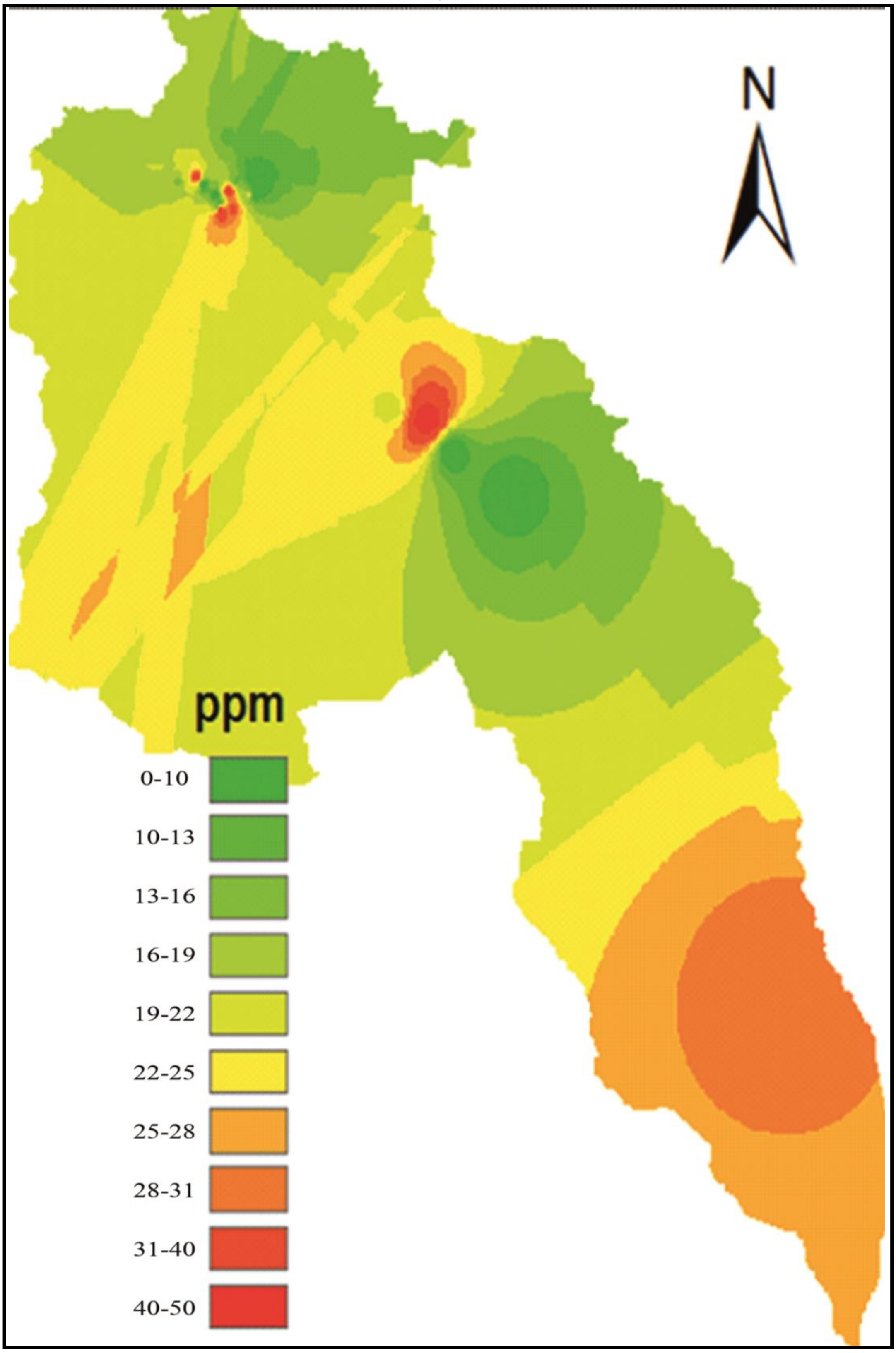


Figure (4.5): GIS map indicating the spatial distribution of BOD in Al-Far’a catchment

3.1.1.5 TDS Results

Table (4.1) shows that the water samples had TDS level within the WHO standard for drinking water, which is 1000 mg/L (Divya and Belagali, 2012) and the FAO guidelines for irrigation water quality (Table 4.1). The highest level of TDS 820 ppm in wells located in wadi Al-Far'a, this value is close from TDS standard. In early studies, inverse relationships were reported between TDS concentrations in drinking water and the incidence of cancer, coronary heart disease, arteriosclerotic heart and other diseases (WHO, 2003). The increase of TDS of water is due to the increase in agricultural run –off that carries nutrients and chemicals, this leads to an increase in water salt. Figure (4.6) shows the spatial distribution of TDS in Al-Far'a catchment.

4.1.1.6 Hardness Results

The classification of water hardness is 0 to 60 mg $CaCO_3$/L is considered as soft, 61 to 120 mg $CaCO_3$/L as moderately hard, 121 to 180 mg $CaCO_3$/L as hard, and more than 180 mg $CaCO_3$/L as very hard (Shomar et al., 2010). All water wells were fond very hard because the lowest level of hardness detected was at 200 mg $CaCO_3$/L in a well located in Ras Al-Far'a. The highest level was observed in a well located in An- Nassariyya 540 mg $CaCO_3$/L. Figure (4.7) shows the spatial distribution of hardness in Al-Far'a catchment

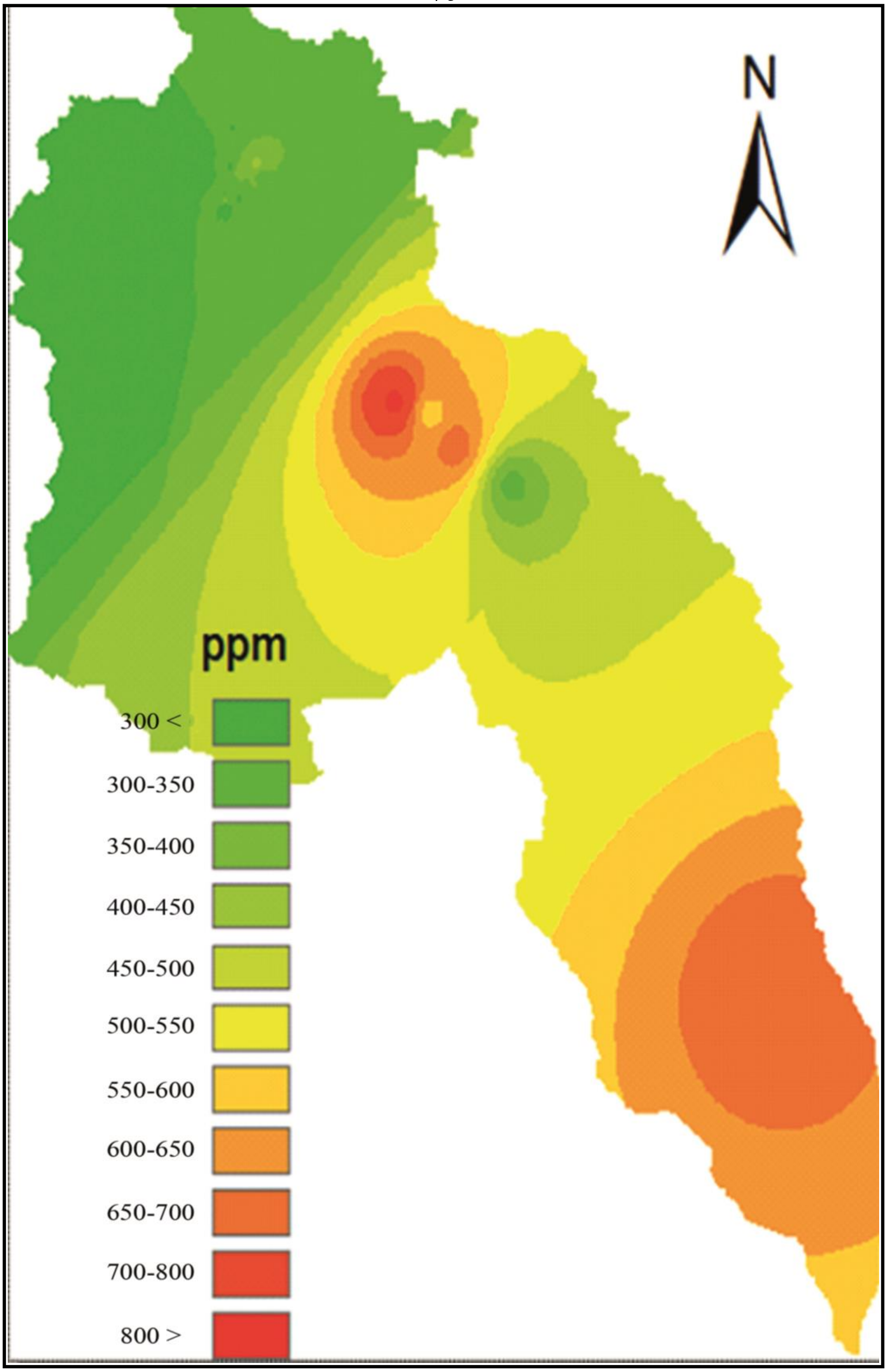


Figure (4.6): GIS map indicating the spatial distribution of TDS in Al-Far'a catchment

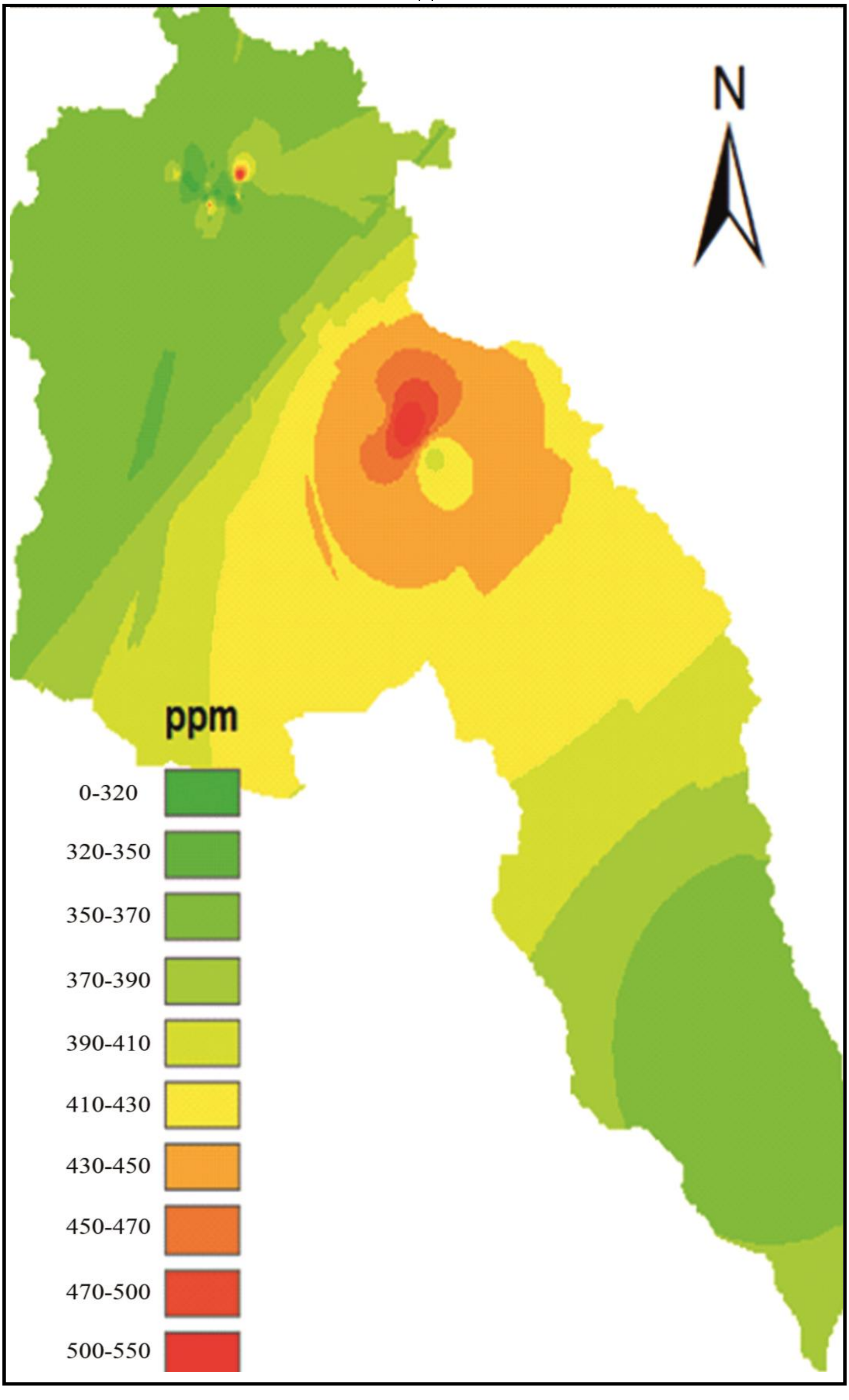


Figure (4.7): GIS map indicating the spatial distribution of hardness in Al-Far'a catchment

4.1.1.7 pH Results

pH in the samples ranged from 7.01 to 7.95 ppm. The highest and the lowest pH were obtained in a well located in Ras Al-Far'a. All water samples were found to be within the permissible limits of the WHO standards for drinking water (7-8.5) (Divya and Belagali, 2012) and guidelines for irrigation water quality (Table 4.1). The results showed that some wells have alkaline pH which is in agreement with the results reported by (Divya and Belagali, 2012**)** that the alkaline pH is particularly due to presence of cations like Calcium, Magnesium and Sodium (Divya and Belagali, 2012).

4.1.2 Soil Results

Table (4.2) shows results of the chemical analysis representing concentrations of nitrates NO_3, phosphate PO_3 and some heavy metals (Cd, Cu, Fe, Ni, Pb and Zn) in soil samples extracted from different three depths in three different locations.

Tukey multiple comparison procedure was applied to make mean separation in order to study if there are significant differences for the level of each pollutant at three depths (Table 4.3).

Tukey□s statistics $T_\alpha = q_\alpha\ (p, f)\ \sqrt{(MS\ error\ /r)}$

Where: f is the number of degrees of freedom, P is the number of treatment (in this study no. of depths p= 3), r is the number of replicates (in this study r=3) and MS is mean square for error.

Two depths means are considered significantly different if the difference between their means is greater than T_α.

Table (4.2): Results of the chemical pollutants (nitrate, phosphate Cd, Cu, Fe, Ni, Pb and Zn) in soil samples at three depths in three different locations.

Area/Depth cm	Concentration (ppm)							
	Nitrate	Total phosphate	Cd	Cu	Fe	Ni	Pb	Zn
Ras Al-Far'a								
0-20 cm	22.6	2626	0.6	47.6	9997.8	63.2	16.6	101.8
20-50cm	55.6	1689.7	0.8	45.4	9364.8	5.96	15.6	103.8
50-100cm	39.9	291.1	0.8	49.0	11365.2	68.4	18.4	108.8
Sahel -Smeet								
0-20	2.2	1193.3	0.4	24.6	6482.6	39.2	9	51.4
20-50	23.3	35.7	1.6	29.4	8097.8	62.6	12	66.8
50-100	5.4	583.3	1.4	25.8	6110.4	40.8	11	59.4
Wad Al-Far'a								
0-20	3.9	3775.0	0.6	36.2	6423.2	42.8	13.4	127.0
20-50	9.4	194.62	0.6	42.6	6808.0	48.0	16.6	140.4
50-100	5.6	2427.4	0.8	37.6	6332.8	47.2	13.6	145.0
Recommended maximum level		69-92***	3**	140**	50000*	75**	300**	300**

References:*Chiroma et al., 2012, **WHO, 2007, ***Mudugamuwa, 2013.

Table 4.3: Mean separation of three depths

Depth (cm)	**Nitrate**	**Total phosphate**	**Cd**	**Cu**	**Fe**	**Ni**	**Pb**	**Zn**
0-20	9.57 a	2584.73 a	0.53 a	36.13 a	7634.53 a	48.40 a	13.00 a	93.40 a
20-50	29.43 a	694.00 a	1.00 a	39.13 a	8090.20 a	38.85 a	14.73 a	103.67 a
50-100	16.97 a	1154.73 a	1.00 a	37.47 a	7936.13 a	52.13 a	14.33 a	104.4 a
T_α	47.64	2837.76	0.93	26.67	5538.15	50.92	8.50	99.00

From the results in Table (4.3), it is noticed that the three depths have the same group (a), so the concentration of all pollutants at the three depths is not significantly different.

4.1.2.1 Phosphate Results

Table (4.2) shows the results of total phosphate concentrations in soil samples at three depths. The maximum amount of soil phosphorus required for agricultural crops (Agronomic Critical Level) is 30-40 (69.0-92.0 ppm as phosphate) (Mudugamuwa, 2013). The levels of phosphate in the soil samples were greater than the amount of soil phosphate required for agricultural crops, That is higher than the permissive levels since the recommended environmental level of phosphorus soil content (Environmental Critical Level) in most countries is 60 (137.0 ppm as phosphate) (Mudugamuwa, 2013). High levels of total phosphate in soil samples are due to several possible reasons, first, there are already phosphate in soil, the bulk of the soil phosphorus is either in the soil organic matter or in the soil minerals (Beegle and Durst, 2002); second, it is clear that there is excessive usage of phosphate fertilizers whether industrial or natural from manure at three locations in the catchment, beside that, the efficiency of plant uptake of phosphorus is very low usually less than 20 percent of the amount of phosphorus applied (Beegle and Durst, 2002).

From Figure (4.8), the highest level of phosphate was found at depth 0-20 cm where the level of phosphate in Wadi Al-Far'a, Ras Al-Far'a and Sahel Smeet were 3829.0, 2678.0 and 1247.2 ppm, respectively. The similar results were reported by (Deubel et al., 2011) and (Olowolafe, 2008). They found that the top soil has higher levels of phosphors.

The accumulation of water-soluble P near the soil surface can reduce the environmental benefits of reduced tillage because the leaching risk of dissolved reactive phosphorus in surface runoff can be increased (Annette Deubel et al., 2011).

The highest average mean level of phosphate at the three depths was found in Wadi Al-Far’a (Figure 4.8), followed by soil collected from Ras Al-Far’a, although the two areas were planted by different crops. There are different factors that play roles in the accumulation of phosphate in soil, such as the amount of phosphors fertilizers, crop type, soil type, soil properties and precipitation.

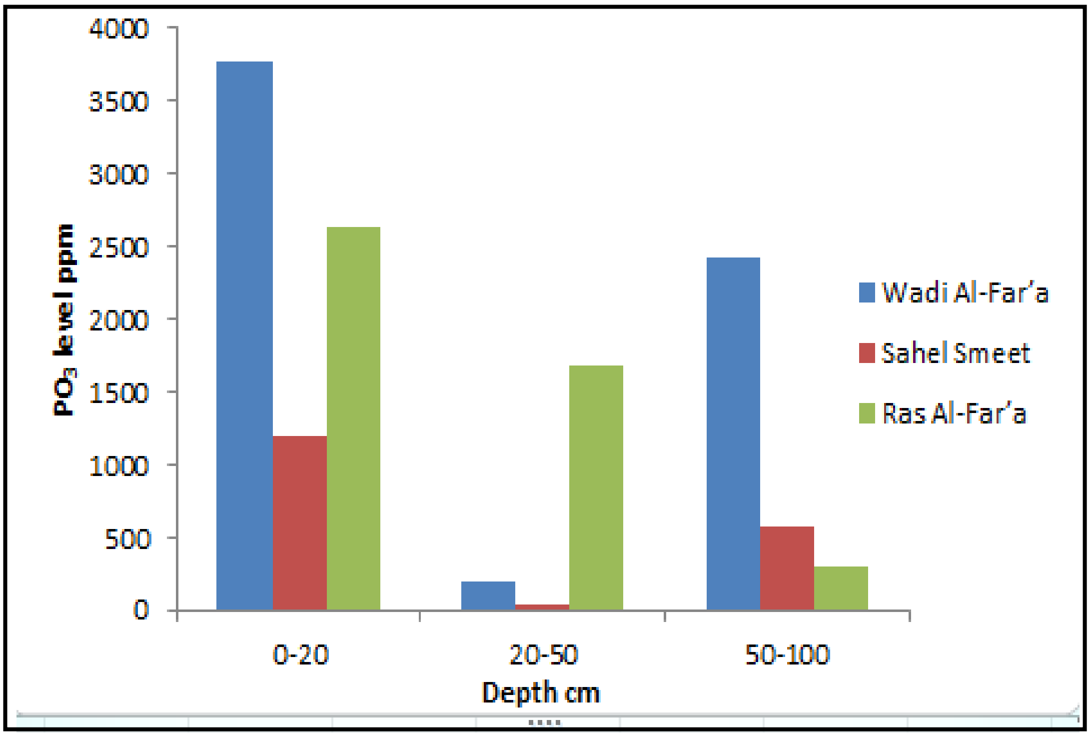


Figure (4.8): Phosphate level in soil at different depths and areas

4.1.2.2 Nitrate Results

The maximum level of nitrate was found at depth (20-50 cm) where the nitrate level in soil samples from Ras Al-Far’a, Sahel Smeet and Wadi Al-Far’a at 20-50 cm was 55.6, 23.3 and 9.4 ppm, respectively. While the lowest levels were found at top soil in all locations, where the nitrate levels in soil samples from Ras Al-Far’a, Sahel Smeet and Wadi Al-Far’a at 0-20 cm were 22.6, 2.2 and 3.9 respectively. These results are in agreement with the results reported by (Rehman et al., 1999) indicating that the nitrate level in upper layer was lower than the level at other depths. They attributed the reason to the upward movement of nitrate from the deeper layer of soil through capillary action resulting in an accumulation of NO_3^- in the layer during dry period (Rehman et al., 1999). The soil samples were collected after a long period after the application of fertilizers. In addition, similar results were observed by (Pez-Bellido et al., 2013) they indicated that the highest nitrate level was at depth 30-60 cm followed by 60-90 and 0-30 cm where the average nitrate was 56, 39 and 26 kg/ha, respectively. Although the phosphate has less solubility than nitrate in water and can't move easily through layers of soil and accumulate in top soil but the phosphate level in deeper layers of soil was higher than the nitrate level, this indicates that there were excessive usage for phosphate fertilizers by farmers.

The results showed that the minimum concentrations of nitrate were found at soil samples collected form Wadi Al-Far’a and Sahel Smeet fields planted by cumber at all depths (Figure 4.9),so the nitrate level is affected by the utilization of nitrate by crops.

There are many reasons that may explain the increasing accumulation of nitrate in soil. These include: the amount of fertilizers used, type of soil, excessive irrigation, precipitation and crop types. Therefore, it can be concluded that cumber has the ability to take up nitrate from soil more than aubergine. The results of nitrate levels in crops support these results (Table 4.5).

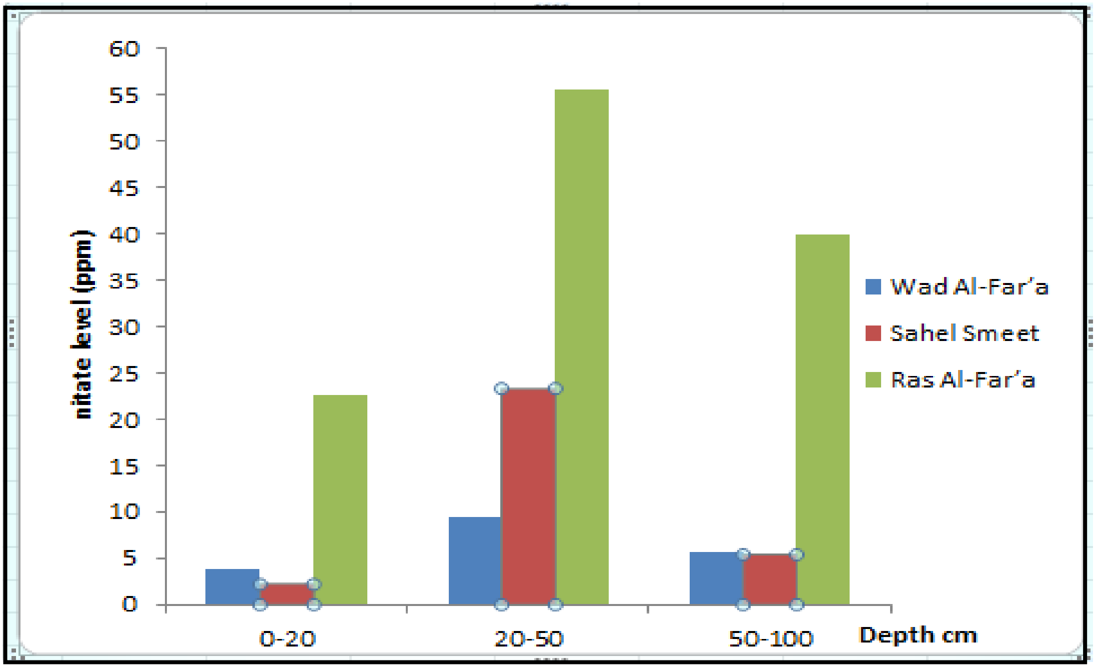


Figure (4.9): Nitrate level in soil at different depths and areas

4.1.2.3 Heavy Metals Results

The results showed that the most accumulated metal was iron. The highest concentration of iron 11365.2 ppm was found at sampling location in Ras Al-Far'a at (50-100 cm) this maybe due to the fact that soil samples were taken from fields where farmers planted aubergines and sprayed sequestrene product that contained 6% iron. Cd levels were the lowest at all samples. Similar results were reported by (Mwegoha et al., 2010). The maximum concentration of cadmium was obtained at sampling location Sahel-Smeet with 1.6 ppm at a depth of 20-50. The order of the concentration of metals is Fe>Zn>Ni>Cu>Pb>Cd. Zn and Cd. These results are in agreement with the results reported by (Zhanget al., 2010) that Zn concentration was the highest where Cd was the lowest.

The results showed that the accumulated concentration of heavy metals was lower than the maximum allowable level (Table 4.2).

High concentration of Cu was recorded where Pb level was high and the highest concentration of Cu and Pb was obtained at 50-100 cm in Ras Al-Far'a 49.0 and 18.4 ppm, respectively. While the lowest concentration was found at 0-20 cm in Sahel-Smeet (24.6 and 9.0 ppm, respectively). Besides, the maximum positive relationship between soil concentrations of heavy metals was obtained by Cu and Pb (r=0.97) and good correlation Cu-Pb (r=0.76) was obtained by (Ioan Suciu et al., 2008). In addition to that, a good correlation obtained by Cu-Fe and Cu-Zn where r was 0.743 and 0.657, respectively. It was noticed that the maximum concentration of Zn was 145.0 ppm in at 50-100 cm in Wadi Al-Far'a, but the minimum concentration was 51.4 ppm in Sahel-Smeet at 0-20 cm. A good positive correlation was obtained by Zn-Pb (r=0.66). Table (4.4) shows that the lowest relation is between the concentration in soil of Ni and Zn (r = 0.02), Fe-Cu (r=0.02), Zn-Fe (r=0.04) and Cd-Fe (r=-0.04).

Results revealed that the heavy metals pollution in the samples from Ras Al-Far'a was much higher than other samples in the other areas.

There is good relations between nitrate level in soil and Fe, Cu and Pb (r =0.82, 0.63 and 0.59, respectively). At the same time, there was a degree of association between phosphate and Cd in soil (r= 0.5) (Table 4.4). Therefore, results indicated that fertilization is considered an important source of heavy metals in soil. It contained a large majority of the heavy metals like Hg, Cd, As, Pb, Cu, Ni, and Cu (Savci et al, 2012), beside that the organic fertilizers increase the building up of heavy metals in soil .

Table (4.4): Correlation coefficients of chemical analysis in soil parameters

	NO_3^-	PO_4^{-3}	Cd	Cu	Fe	Ni	Pb	Zn
NO_3^-	1							
PO_4^{-3}	-0.19	1						
Cd	0.11	0.50	1					
Cu	0.63	0.17	-0.38	1				
Fe	0.82**	-0.16	-0.04	0.74*	1			
Ni	-0.24	-0.21	0.16	0.10	0.27	1		
Pb	0.59	0.0	-0.24	0.97**	0.72*	0.23	1	
Zn	0.031	0.4	-0.41	0.66	0.038	0.022	0.66	1

(Significant levels:* =P<0.05, **=p<0.01)

4.1.3 Crops Results

Table (4.5) shows the results of nitrate, phosphate and some heavy metals (Cd, Cu, Fe, Ni, Pb and Zn) in cucumbers and abuergine samples in four parts (leaves, fruit, fruit peels and Shoot).

Table (4.5): Results of the chemical pollutants (nitrate, phosphate Cd, Cu, Fe, Ni, Pb and Zn) for cucumbers and aubergine samples

Plant /parts	Concentration							
	Nitrogen g/kg	Phosphate ppm	Cd ppm	Cu ppm	Fe Ppm	Ni ppm	Pb ppm	Zn ppm
Aubergine								
Leaves	20.16	5309.2	0.8	15.6	73.4	3.6	1.6	29.4
Fruit peels	5.88	2171.2	0.2	7.8	16.6	4.8	0.8	14.4
Essence	17.92	1917	1.2	8.8	14.2	3.6	1.8	20.0
Shoot	13.44	2836.2	1.0	14.6	58	3.8	2.0	93.0
Cucumber								
Leaves	22.68	7102.2	0.2	19.6	66.4	3.8	2.4	30.6
Fruit peels	7.84	2293.7	1.0	21.75	32.0	6.0	3.25	43.5
Essences	14.0	4106.3	0.5	16.0	24.5	4.25	1.25	40.0
Shoot	17.64	4741.8	1.0	28.0	680	8.0	1.88	50.6
Recommended maximum level WHO/FAO	----	------	1*	30*	48*	10**	2**	60*

Refrences:*WHO, 1996, ** Opaluwa, et al., 2012.

Tukey multiple comparison procedure was applied to estimate mean separation to study if there are significant differences for the level of each pollutants at the four parts of the two crops (Table 4.6). Tukey□s statistics test equation is as the same equation used in soil results but P stands for no. of parts = 4 and r =2.

Table (4.6): Mean separation of part of two crops.

Part	Nitrogen	Phosphate	Cd	Cu	Fe	Ni	Pb	Zn
Leaves	21.42 b	62505.7 a	0.50 a	17.60 a	69.90 a	3.70 a	2.00 a	30.00 a
Fruit peels	6.86 a	2332.45 a	0.60 a	14.78 a	24.30 a	5.40 a	2.03 a	28.95 a
Essence	15.96 ab	3011.65 a	0.85 a	12.40 a	19.35 a	3.93 a	1.53 a	30.00 a
Shoot	15.54 ab	3789.0 a	1.00 a	21.30 a	359.0 a	5.90 a	1.94 a	71.80 a
T_{α}	9.46	4915.81 a	1.76	30.27	924.9	6.37	3.80	79.47

It is noticed Form Table (4.6) that the four parts have the same group (a) for all pollutants except nitrogen, so the pollutants level at the four parts of the two crops was not significantly different except for Nitrogen which had a significant difference between leaves and fruit peels.

4.1.3.1 Heavy Metals Results

The results of heavy metals in Table (4.5) revealed that among heavy metals Fe was the most accumulated in the crops elements, followed by Zn, Cu, Ni, Pb and the least was Cd. Similar results were obtained by (Abou Auda et al. , 2011) who studied the accumulation of heavy metals (Fe, Zn, Pb and Cd) in crops in Gaza Strip. Similar results were also obtained by (Zhang et al., 2010) that the maximum concentrations was Zn, followed by Cu, Cr, Ni, Pb and Cd for two crops (Cyperusmalaccensis and Scirpustripueter).

The results showed that the metal concentrations in cucumber were higher than those in aubergine except Cd. Cucumber showed stronger ability to accumulate these metals from soils than aubergine.

The difference in the level of heavy metals contamination between different crops is due to their morpho-physiologi differences in terms of heavy metal content, exclusion, accumulation, foliage deposition and retention efficiency (Naser et al., 2011).

Analyzing the obtained results showed that aubergine and cucumber parts accumulated Zn mostly in shoots 50.6 and 93 ppm, respectively. The level of Zn in aubergine shoot was higher than the maximum the FAO/WHO standards (Table 4.5). Pb concentration was higher in cucumber peel and aubergine shoot 3.25 and 2 ppm, respectively. While Fe was mostly accumulated in aubergine and cucumber shoot and leaves, most studies found that iron is most accumulating in green leaves. The results indicated that the cucumber peel has stronger ability to accumulate heavy metals from soils than cucumber essences, but Fe and Ni were mostly accumulated in aubergine shoot than essences. Therefore, the results suggested that accumulation of metals depends on plant organs.

Heavy metal content in crops can be affected by several factors including metal concentrations in soils, soil pH, cation exchange capacity, organic matter content, types and varieties of crops, and plant age. From which metal concentration in soil is the dominant factor (Naser et al., 2011).

In both crops, Ni and Cu level were below the WHO permissive levels (Table 4.5). In the other hand, the level of Fe in shoots and leaves of both crops, and the level of Pb in cucumber fruit peel and leaves were higher than the maximum permissible value of the WHO/FAO. Although the levels of heavy metals in some edible and non –edible parts were within the permissible value, however; the continual consumption could lead to accumulation and adverse health effects will occur particularly for Pd, and Cd (Opaluwa, et al., 2012).

4.1.3.1.1 Heavy metals distribution among soils and crops

Heavy metal concentrations values were higher in soil samples compared to crops samples. (Naser et al., 2011) reported that the level of heavy metals in crops were generally lower than the soil samples. These results might be attributed due to root activity, which seems to act as a barrier for translocation of metals.

Table (4.7) shows the transfer factor (TF) of different heavy metals from soil to crops calculated as the ratio between the average concentrations of heavy metals in crops and their concentration in soil.

In cucumber the TF factor was Cd>Cu>Zn>Pb>Ni>Fe, while TF in aubergine was Cd> Zn>Cu>Pb>Ni>Fe. The results showed that Cd had the highest TF in both crops.

Similar results were reported by (Naser et al., 2011) where they found that Cd had the highest TF among other metals and the order was Cd, Ni, Pb and Co, they also reported that the high mobility of Cd with a natural occurrence in the soil and the low retention of Cd in the soil than other toxic cations may elevate the TF of Cd. In a study conducted by (Opaluwa, et al., 2012), the highest TF of metals was for Cu and the order was Cu, Co, Fe, As Zn, and Ni. The food-chain crops might absorb enough amounts of heavy metals to become a potential health hazard to human (Abulude, 2005), that means that Cd, Cu and Zn pose the greatest threat among metals studied because of the elevated TF.

Table (4.7): Transfer factor of heavy metals form the soils to crops

	Cd	Cu	Fe	Ni	Pb	Zn
Aubergine	1.3	0.25	0.004	0.06	0.093	0.38
Cucumber	0.93	0.59	0.03	0.13	0.16	0.32

4.1.3.2 Nitrogen Results

The results of concentration of N in cucumber and abuergine are shown in (Table 4.5). The results showed that the content of N in all samples of crops was less than the maximum level for nitrates as recommended by the WHO and the FAO 2500 mg kg^{-1}. This means that the crops are safe for consumption (Cigulevska, 2004).

The results showed that leaves of cucumber and aubergine have the highest ability to accumulate N 22.68 and 20.16, respectively. (Kim et al., 2011) reported similar results that the nitrate contents of leafy vegetables were higher than those of root vegetables like onion, and lotus root and fruiting vegetables such as pepper, because chlorophyll contents in leaf blade showed the highest concentration of nitrate contents in the vegetables. (Kim et al., 2011) and (Centre for Food Safety et al., 2010) reported that the leaves accumulate nitrate more than other parts.

The fruit peels are the lowest part that accumulated N (Figure 4.10). The results suggested that the essence of cucumber and aubergine contained higher N contents than the peel, where N level in the peel was 7.84, 5.88

g/kg for cucumber and aubergine respectively. Therefore, a nitrate level varies in the different parts of both crops.

Figure (4.10) suggest that N was more accumulated in leaves, shoots and peels of cucumber than in aubergine. Except that the level of N in the essence of aubergine was higher than its level in cucumber 17.92 and 14.0 g/kg, respectively, so N has higher ability to accumulate in cucumber than aubergine.

The factors that influence the nitrogen level in crops are: crop type, fertilizers amount and types, soil moisture, light intensity, temperature, and crop protection strategies (EFSA, 2008).

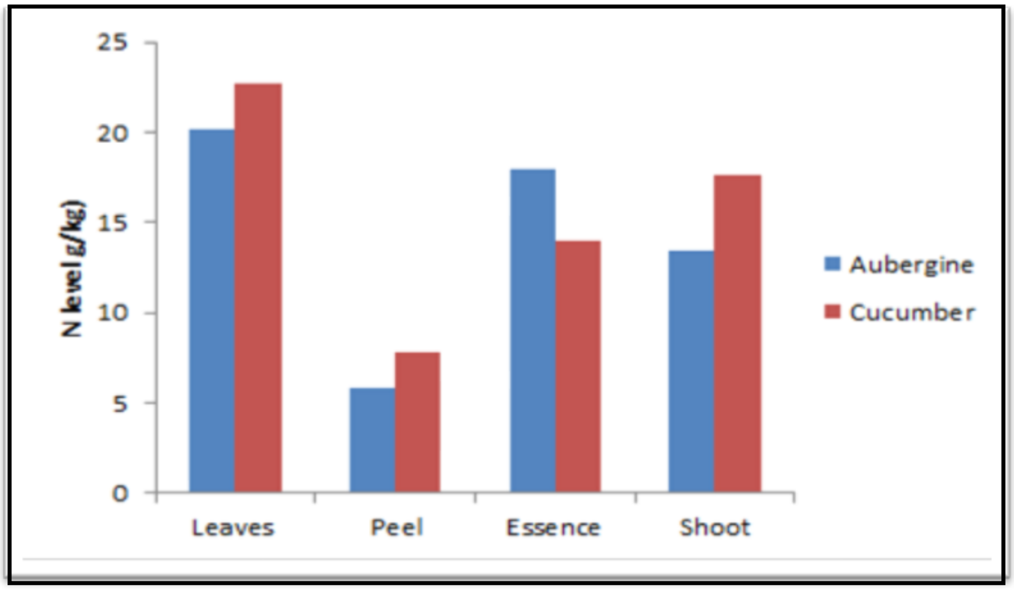


Figure (4.10): Nitrogen level in parts of the cucumber and aubergine

4.1.3.3 Phosphate Results

The results of phosphate analysis (Table 4.5) showed that the concentration of phosphate was higher in cucumber than aubergine at all parts.So the ability of cucumber to accumulate phosphate was higher than aubergine, although the concentration of phosphate in the soil samples where aubergine was planted was higher than in the soil where cucumber was planted.

Figure (4.11) indicates that phosphate concentration was higher in the leaves than other parts of both cucumber and aubergine 5309.2 and 7102.2 ppm, respectively, followed by shoots 2836.2 and 4741.8 ppm, respectively.

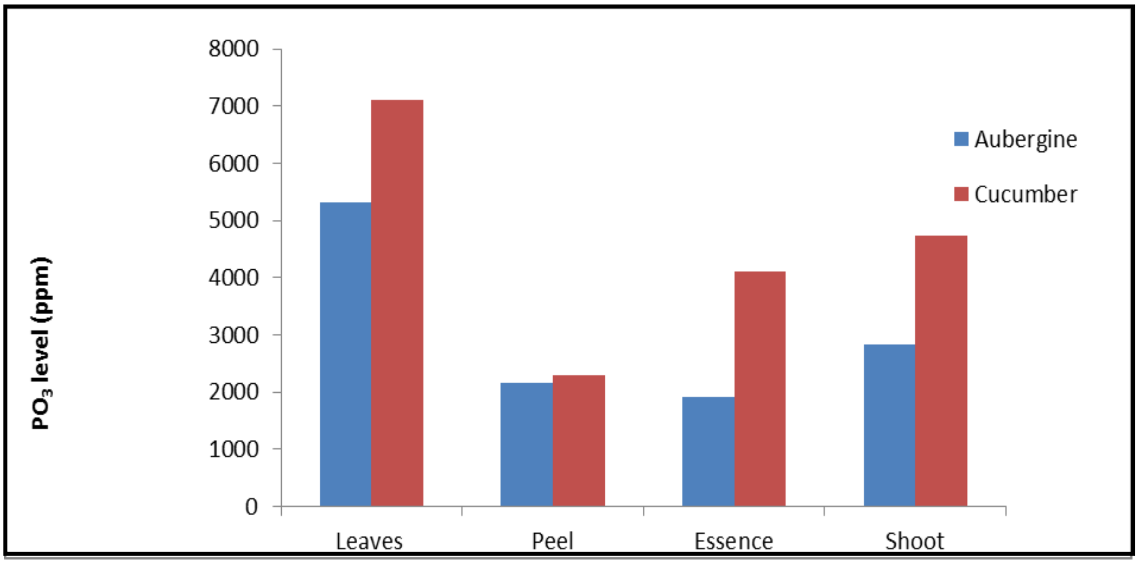


Figure (4.11): Phosphate level in parts of the cucumber and aubergine

The present study showed that aubergine peel contained higher phosphate contents than the essence, the average phosphate levels in the peel were 2171.2 and 1917.0 ppm, respectively, while in cucumber the levels were 2293.7 ppm in the peel and 2293.7 ppm in the essence.

Phosphorus concentration in the crops parts increased with increasing rates of P application from different fertilizers (Mejbah Uddin et al., 2012).

4.1.4 Pesticides Residues Results:

4.1.4.1 Lufenuron Residues in Soil and Green Bean

The results presented in Table (4.8) revealed that the maximum concentration of lufenuron in soil was found at top soil layers (0-20 cm), and the residue of pesticides decreased with increased depth, because lufenuron is slightly mobile to immobile in soil (EFSA, 2008).

Table (4.8): The residue of lufenuron in soil and green bean

Sample	Soil			Green Bean
	0-20	20-50	50-100	
Residues level (ppm)	6.5	1.3	0.8	4.3

The residues of lufenuron in green bean was 4.3 ppm, there isn't MRL established for green bean by FAO/WHO (Hassan et al., 2013). While the European Union proposed that MRL for lufenuron in green beans is 0.02 ppm (EU, 2013). It noticed that the level of lufenuron in green been was higher that MRLs, so green bean needs more time before being harvested to allow for lufenuron to degrade by sunlight to became safe to customers .

4.1.4.2 Abamectin Residues in Soil and Abuergine

The results in Table (4.9) are abamectin concentrations at three soil depths and in aubergine. Soil results showed that the highest residue of abamectin was at top soil (0-20) cm at a level of 2.1 ppm. Abamectin level in soil decreases with depth, because abamectin mobility through soil is very low and it is highly lipophilic substance that dissolved in most organic solvents, but poorly soluble in water (Ming Xie et al., 2006), and it was classified as immobile (CEPA, 1993).

Table (4.9): Residual levels of abamectin in soil and aubergine

Sample	Soil			Aubergine
	0-20	20-50	50-100	
Residues level (ppm)	2.1	0.0012	0.32	0.3

For plant, the level of abamectin in aubergine was 0.3 ppm. This residue level exceeded the upper limit of the maximum allowed residue set by the

Codex Committee on Pesticide Residues under the Joint FAO/WHO Food Standards Program at 0.01–0.02 mg/kg for fruits (Kamel et al., 2006). Similar results were reported by (Kamel et al., 2006) where the abamectin residue in date exceeded the allowable limit, but after 14 days from application the residue deceased and the level became within standard limit. Therefore, aubergine crop needs more days before harvest to become safe to customers.

4.2 Field Questionnaire Results

4.2.1 Social Characteristics and General Agricultural Information

4.2.1.1 Number of Farmers

Total number of respondent farmers that answered the field questionnaire is 155 farmers distributed as follow: 65 farmers from Wadi Al-Far'a, 49 farmers from Ras Al-Far'a, 21 from Al-Jiftlik and 20 from An- Nassariyya

4.2.1.2 Social Characteristics of the Respondent Farmers

Males represent (91.0%) of the respondent farmers, (50.3%) of the farmers were above 40 years old, while (45.65%) of farmers were 18-40 years old, small portion of respondent farmers were children. (53.2%) of farmers were smokers. Analysis of the educational status of the farmers showed that (5.3%) were illiterate, (9.3%) had passed primary education, (24.7) had finished preparatory school, (30.0%) had finished secondary school and (30.7%) had university degree. A low level of illiterate was recorded among the respondents reflecting an educated community, this result has agreement with the result reported by (Al -Faris, 2007).

A percentage of (71.1 %) of the farmers are only working in the agricultural sector, the remaining percentage works in other public and private sectors beside their farming job. (44.3%) of the farmers are working in rented farms, while (40%) of the farmers are working on their own fields and the rest are employed as workers in other peoples farms.

4.2.1.3 Crops Selection:

Farmers were asked about the main reasons for crop selection, the results showed that the leading determinants of crop selection are market demand (43.2%), quantity of water needed and its availability (26.4%), availability of agricultural inputs (24%) and land size (7.4%), while the cost of agricultural inputs was mentioned by only (4.1%) of farmers (Figure 4.12).

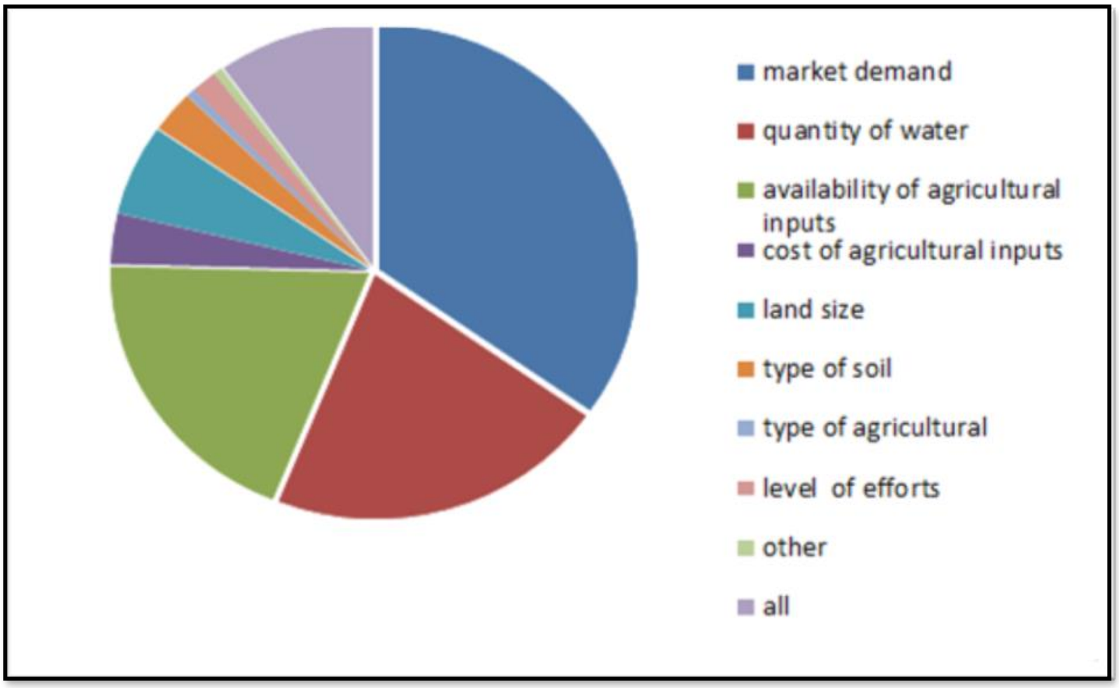


Figure (4.12): The distribution of farmers' reasons for crop selection

4.2.2 The Knowledge and Attitude of Farmers about Agrochemicals

First, (98.6%) of the farmers use pesticides but only (1.4%) do not use pesticides, maybe the portion that's not using pesticides have home garden so do not need pesticides. Most target farmers in Wadi Al-Far'a, An-Nassariyya and Al-Jiftlik use pesticides.

Figure (4.13) shows that answers of the farmers about whether they have received the extension service, (66.0%) of the farmers answered that sometimes they have received agricultural extension service from engineers, but (24%) answered that they never had such services.

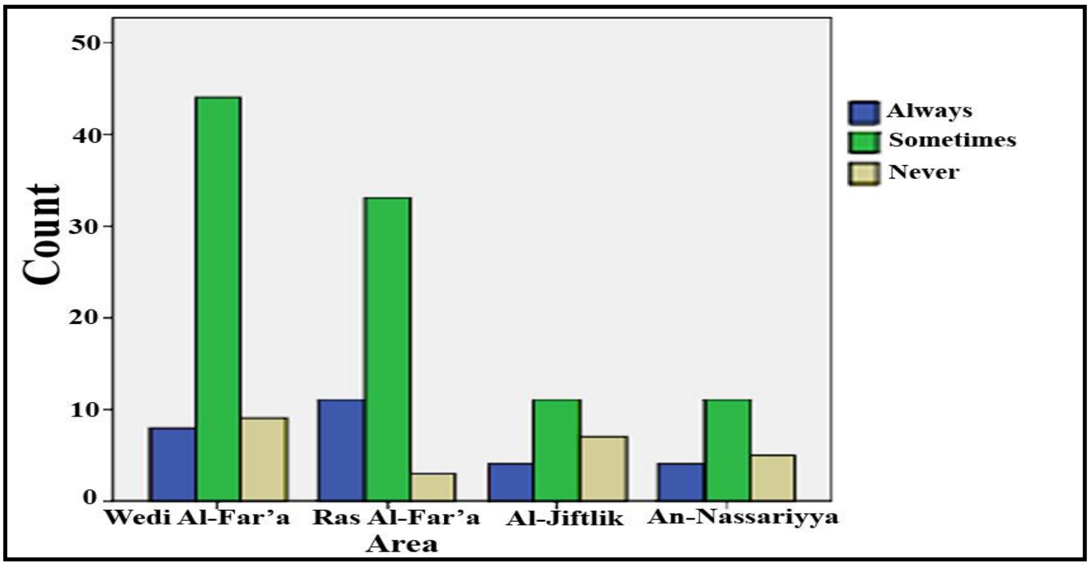


Figure (4.13): Distribution of farmers about receiving an extension service

The results showed that (51.7%) of the farmers used pesticides for more than five years. (51.3%) of the farmers applied agrochemicals (pesticides and fertilizers) by themselves. However, (27.9%) of the farmers gave this job for other family member, Note that this person may be unqualified for this job and may expose his health and the environment to risks. (6.0%) of the farmers brought a qualified person from the ministry of agricultural.

Most farmers got their information about agrochemicals from their practical experience (51.3%). (33.8%) of farmers got information from agricultural engineers. Low percentage of farmers got information from the ministry of agriculture or agricultural associations (2.6% and 1.9%, respectively), in addition (0.6%) of farmers got information from TV and radio (Figure 4.14).

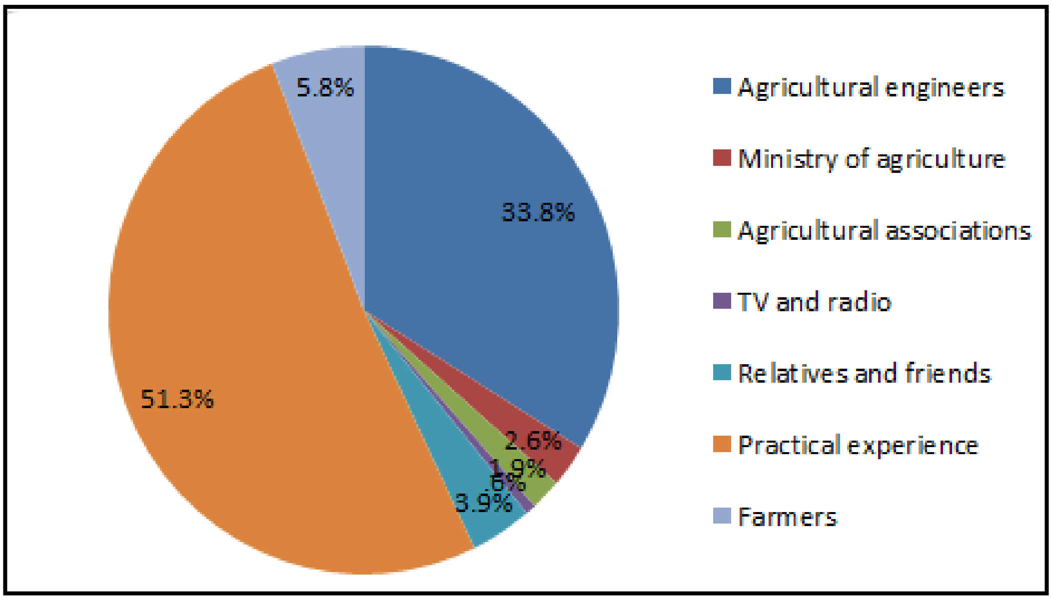


Figure (4.14): Distribution of farmers' information source about agrochemicals

An-Nassariyya farmers are highly depended on their practical experience for agrochemicals usage, while Ras Al-Far'a farmers showed higher dependency for information from agricultural engineers.

Farmers who had finished primary school represented the highest portion of farmers depending on agricultural engineers to get information about agrochemicals type and quantity (37.8%), while illiterate farmers represented the highest portion of farmers depending on friends and relatives as sources of information (25.0%), where's farmers who had finished secondary school get information from TV and radio than other farmers.

An-Nassariyya farmers highly depended on their practical experience for how usage agrochemicals, which Ras Al-Far'a farmers were more farmers who depended of the information given by agricultural engineers.

(68.4%) of farmers have not received any formal training for agrochemicals usage (Figure 4.15). It is also noticed that the number of farmers who have received formal training in Wadi Al-Far'a and An-Nassariyya is higher than the other areas.

Most farmers in the catchment bought agrochemicals from legal agricultural stores (98.4%), while only (2.8%) of them got agrochemicals from supplements by the Ministry of Agriculture, so it is noticed that there is not enough support to farmers by the Ministry of Agriculture regarding agrochemicals supplies.

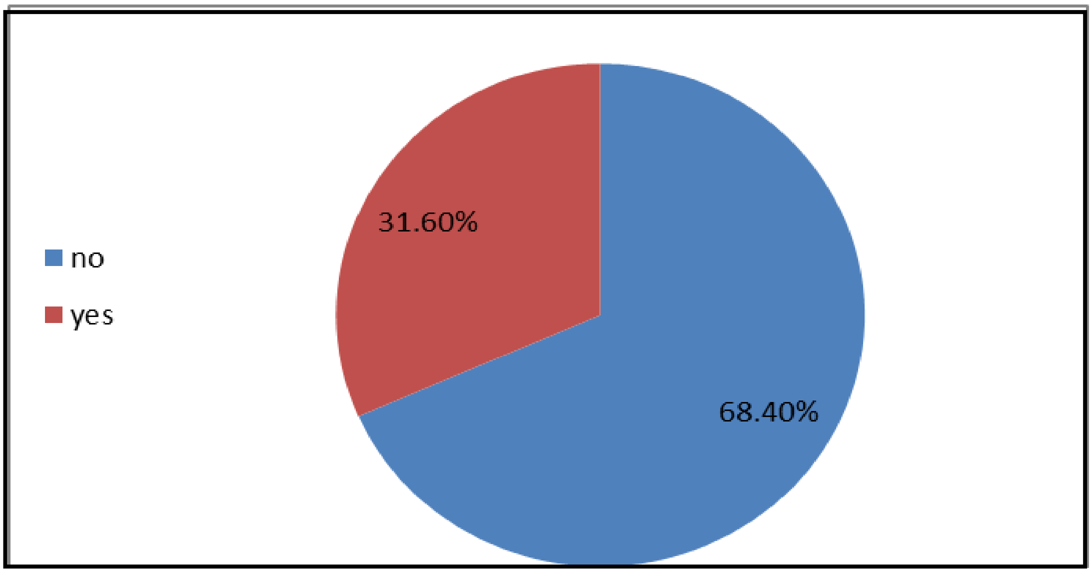


Figure (4.15): Formal training on agrochemicals usage for the catchment farmers

Agrochemicals products effectiveness were the major factors influencing the farmers to buy a specific agrochemicals (41.9%), followed by the agrochemicals effect on health and environment (16.1%), while the availability of information and instructions on the product label and cost of the product had the lowest percentages (14.2%), (13.5%), respectively (Table 4.10). Only (10.3%) of the farmers were concerned in whether the agrochemicals is banned in Palestine or not, Al- Jiftlik farmers were the most concerned in this factor. While An-Nassariyya farmers were not interested at all on whether the agrochemicals is banned or not, but they were the most farmers taking agrochemicals cost as the influencing factor on agrochemicals choice (20.0%).

Table (4.10): The factors that were influencing the farmers when buying agrochemicals

Factors	Wadi Al-Far'a	Rass Al-Far'a	Al-Jiftlik	An-Nassariyya	Total
Product cost	9.4%	18.4%	9.1%	20.0%	13.5%
Availability of information and instructions on label	15.6%	6.1%	18.2%	25.0%	14.2%
Effects on environment and health	10.9%	22.4%	18.2%	15.0%	16.1%
Effectiveness of product	50.0%	38.8%	27.3%	40.0%	10.3%
Not banned	10.9%	10.2%	18.2%	0.0%	41.9%
Other	1.6%	2.0%	0.0%	0.0%	0.0%
All	10.6%	2.0%	9.1%	1.3%	13.5%

Most farmers tend to mix two or more different types of pesticides before application (84.5%). This result is in agreement with the results obtained by (Yassin et al, .2002) in Gaza where (85.7 %) of the farmers mixed two or more pesticides. An–Nassariyya farmers have the highest percentage for mixing two or more pesticides (90.0%), while the percentage get by Al-Jiftlik and Wadi Al-Far'a was (80.8%).

The main reason that farmers used to mix pesticides was to increase their effectiveness (66.7%). While (2.9%) mixed pesticides because they are unsure about the pesticides quality, only (19.4%) of the farmers mixed pesticides according to the label and agricultural engineer instructions. While (5.0%) of farmers followed the suggestion of others. Regionally, Wadi Al-Far'a farmers were the most farmers following the label instructions than other farmers (22.8%), while the most farmers following the agricultural engineer was Ras Al-Far'a farmers (29.8%) (Table 4.11).

Table (4.11): Farmers reasons for mixing two or more different types of pesticides

	According label instruction	Increase the effectiveness of pesticides	Unsure from quality of the pesticide	According agricultural engineering instructions	Everybody else mix
Wadi Al-Far'a	22.8%	50.9%	3.5%	19.3%	3.5%
Ras Al-Far'a	17.0%	48.9%	.0%	29.8%	4.3%
Al-Jiftlik	11.1%	66.7%	5.6%	.0%	16.7%
An-Nassariyya	11.1%	66.7%	5.6%	.0%	16.7%
Total	11.1%	66.7%	5.6%	.0%	16.7%

Illiterate farmers were the most farmers mixing two or more pesticides to increase pesticides effectiveness (85.7%), while farmer who had finished secondary school were the most farmers who mixed pesticides according to the label and engineers instructions (26.2%), farmers who had university degree were the most farmers who mixes pesticides because farmers around do the same (13.2%). There was no relation between the educational status and reasons for mixing two different brands of pesticides (p = 0.149, P value of χ^2 test).

A percentage of (87.8%) of the farmers used recommended concentrations of agrochemicals as recorded on the label or engineer instructions, while (10.1%) of the farmers increased the concentration. Small number of farmers decreased the concentration (2.0%). (Zyoud et al., 2008) reported that most farmers in the West Bank prepared pesticide at the recommended concentration (50.4%) (Table 4.12).

Table (4.12): Preparing of agrochemicals concentration

Area	Recommended concentration	Increased concentration	Decreased concentration
Wadi Al-Far’a	95.2%	4.8%	.0%
Ras Al-Far’a	86.7%	11.1%	2.2%
An-Nassariyya	65.0%	25.0%	10.0%
Al-Jiftlik	90.5%	9.5%	.0%
Total	87.8	10.0	2.00

Wadi Al-Far’a farmers were the most farmers who used recommended agrochemicals concentrations as recorded on the label or engineer instructions, while An-Nassariyya farmers were the most farmers who increased the concentration (Table 4.12). Increasing the effectiveness of pesticides and increasing pest incidence were the main reasons to increase the concentration of agrochemicals chosen by farmers (32.9%). (7.1%) of the farmers said that everybody else increased. By region, increasing the effectiveness of agrochemicals is the main reason for increasing concentration in Al-Jiftlik, Ras Al-Far’a and An-Nassariyya (55.6, 33.3 and 33.3% respectively). While Wadi Al-Far’a farmers refered the reasons for increasing the concentration to more frequent pest incidence and to follow the supplier instructions. (32.0%) (Table 4.13).

(93.9%) and (90.7%) of the farmers who had finished primary and preparatory school, respectively prepared agrochemicals at the recommended concentration. While (12.5%) of illiterate farmers increased agrochemicals concentration, beside that there was no relation between agrochemicals concentration preparation and the education level (P = 0.830 P value of χ^2 test).

A percentage of (96.2%) of the farmers who have received agricultural extension service prepared agrochemicals at the recommend concentrations while (3.8%) of them increased concentration, (17.4%) of the farmers used the recommended concentration although they have not received extension service, while (17.4%) of them increased concentration. However, there was no relation between received extension service and preparing agrochemicals (P = 0.419, P value of χ^2 test).

Table (4.13): Reasons for increasing agrochemicals concentration

Reason/Area	Wadi Al-Far’a	Ras Al-Far’a	An-Nassariyya	Al-Jiftlik	Total
Increase the effectiveness of pesticides	24.0%	33.3%	33.3%	55.6%	32.9%
According to supplier instruction	32.0%	25.9	22.2%	0%	24.3%
More pest incidence	32.0%	33.3%	22.2%	44.4%	32.9%
Everybody else increased	8.0%	3.7%	22.2%	0%	7.1%
Other	4.0%	3.7%	0%	0%	

A percentage of (78.9%) of the farmers have never bought non- labeled agrochemicals (pesticide and fertilizer), while (2.0%) of the farmers always buy non- labeled agrochemicals .By region, the percentages of farmers who have never bought non- labeled agrochemicals bottles in Wadi Al-Far'a, Ras Al-Far'a, An-Nassariyya and Al-Jeftilic were (51.0, 31.0, 15.0 and 19.0%, respectively).

A percentage of (86.8%) of the farmers used fertilizers, but (13.2%) did not use them. Ras Al-Far'a farmers were the most farmers who did not use fertilizers (24.4%).

A percentage of (88.3%) of the farmers used chemical and natural (manure) fertilizers. (3.9%) of the farmers have just used manure. Ras Al-Far'a farmers were the most farmers who have just used manure (6.1%), while An-Nassariyya farmers were the most farmers who have just used chemical fertilizers (10.2%). Farmers were asked about the reasons for not using fertilizers, the results showed that the main reasons were the unavailability of them (42.0%), followed by financial reasons (17.0%), soil degradation (16.0%) – because the excessive use of fertilizers leads to soil degradation -, and it is not important for agriculture (6.0%), while environment pollution was only mentioned by (1.0%) of the farmers. Most farmers in An-Nassariyya and Al-Jeftilc did not use fertilizers for financial reasons (45.5 and 30.8%, respectively), while the unavailability of the fertilizers was the main reason for not using them in Wadi Al-Far'a and Ras Al-Far'a (52.3 and 50.0%, respectively).

A percentage of (53.4%) of the farmers used amino acid fertilizers. Ras Al-Far'a farmers were the most farmers who used them (65.2%), while An-Nassariyya and Wadi Al-Far'a farmers were the least who used them. Humic acid and their products such as obteic is the most amino acid used by farmers. Humic acid is known to improve nutrient absorption and plant growth. Humaic acid can reduce nitrogen fertilizers which can help in reducing the amount of N in the ground water. A high level of nitrogen in the ground water is becoming a serious problem (Rengrudkij and Partida, 2003).

The main factor that the farmers consider when adding fertilizers was the type of crops (48.3%), since the adsorption of the fertilizers is different from one plant to another. A percentage of (19.2%) of the farmers considered soil type and condition, since soil type and the amount of mineral elements available in the soil are important factors in determining the fertilization processes. While irrigation systems and the type of agriculture are other factors that farmers consider when adding fertilizers (7.9%, 13.2%, respectively).

A percentage of (52.4%) of the farmers used phosphoric acid as a fertilizer because it is more soluble in water than phosphate fertilizers. However, excessive use of phosphoric acid can cause several pollution problems to soil and water.

Most farmers used compost fertilizer (32.7%) because it is available in all agricultural shops at considerable prices. A percentage of (29.1%) of the farmers used micronutrient fertilizers as types of fertilizers. (20%) of the farmers used green manure as a source of nutrients to soil, green manure is added after the harvest of some kinds of crops and left in the farm to decay because it supplies nutrients and organic matter to the soil, such as barsem clover. (11.8%) of the farmers used microbial fertilizers. Regionally, green manure was used by majority respondents in Ras Al-Far'a (33.3%). Micronutrient fertilizers were most used by Wadi Al-Far'a farmers (33.3%). While An-Nassariyya and Al-Jiftlik farmers were the most farmers who used compost than others (84.6 and 43.8%, respectively).

4.2.3 Evaluation of Farmers Dealing with Agrochemicals Before, During and After Application

A percentage of (81.5%) of the farmers stored agrochemicals in special stores in their farms, but (16.6%) of the farmers stored them in the houses although they represent a low percentage but this practice still put children and family at risk. Similar results were obtained by (Yassin et al., 2002) who reported that most farmers in a study in Gaza stored agrochemicals in farm (78.8%) while (18.0%) of the farmers stored them in home. An-Nassariyya farmers the most farmers who stored agrochemicals in houses (35.0%), there was no relation between agrochemicals storage and educational level (P= 0.886, P value of χ^2 test), most of farmers whether had university or primary or secondary or preparatory degree or illiterate stored agrochemicals in especially store for them in the farm (76.1%, 71.4%, 86.0%,83.3% and 85.7% respectively).

Most farmers burned empty bottles (65.8%). Burning empty agrochemicals containers in open fires or burying empty containers should not be used as a method of management and disposal because safe burning procedures require good understanding of pesticide chemistry, while safe burial requires adequate knowledge of local hydrology as well as of the environmental behavior of pesticides (Zyoud et al., 2010). (28.9%) of the farmers disposed agrochemicals empty containers in landfill, but a low percentage of the farmers (2.0%) reutilized the containers for house purposes and this practice expose family health to serious risk. Ras Al-Far'a farmers were the most farmers who disposed containers by burning (75.0%) while An-Nassariyya farmers were the most farmers who disposed them in garbage sites (63.2%). The safest way to dispose empty bottles and excess solution is to follow the label instructions in order to reduce the risk on human and environment.

Table (4.14) shows a list of safety procedures used by farmers during and after agrochemicals application. The highest percentage of respondents (41.5%) wore coveralls. While some farmers wore hand gloves and a hat (11.3%). Agrochemicals can enter the body through skin, eyes, mouth and airways. Farmers need to use personal protective equipment (PPE) during handling and applying pesticides in order to protect themselves from pesticide exposure. Only (35.5%) of Al-Jiftlik farmers wore gloves. While Ras Al-Far'a farmers were the most farmers who wore coveralls (48.9%). In Wadi Al-Far'a (43.3%) of the farmers wore coveralls.

Highest percent of respondent observed wind direction (68.9%), because of the risk of exposure to the applicator, pesticide should be sprayed on the wind direction (Sultana et al., 2001).

Table (4.14): Safety procedures practices used by farmers during and after agrochemicals applications

Protective measure used by respondent	(%)
Hand gloves	14.1
Oral –nasale masks	4.2
Wide hate	14.1
Special boot	2.6
Goggles	1.4%
Over -all protective cloths	41.5
Observed wind direction	68.9
Showered after application	32.0
Change clothes after application	37.9

Some farmers used to smoke and eat during application (26.5% and 4.5% respectively), this practice exposes farmers health to risk, because smoking and eating facilitates the entry of poisonous substances to the body (Raha). A percentage of (68.9%) of the farmers always observed raining time before and after application. An-Nassariyya farmers were the least farmers who observed raining time. Agrochemicals should not be sprayed when it is raining because rain will wash agrochemicals from the site of application and cause run off with risk of environment pollution.

Most farmers irrigate crops before spraying (32.9%), and (30.1%) of the farmers mix agrochemicals with irrigation water.

A percentage of (32%) of the farmers used to take a shower after agrochemicals application. A high percentage of the farmers always wash their bodies, clothes and equipments far away from water sources such as wells (82.6%). There was a relation between this practice and the educational level (p=0.02, P value of χ^2 test). In addition, (51.7%) of the farmers have never washed sprayers tools and containers in water resources. However, (26.5%) of the farmers were always used to wash sprayers tools and containers in water resources, this practice exposed water resources to pollution.

Wadi Al-Far’a and An-Nassariyya farmers were the most farmers who were always used to wash sprayer tools and containers in water resources (30.6% and 30.0%, respectively). Ras Al-Fars farmers were the most farmers who did not avoid water sources nearby when washing their bodies (78.1%).

Among the surveyed (36.4%) of the farmers re-sprayed the remaining sprayers tools solution again until its finish, some farmers disposed the remaining solution in the farm or in the drainage (10.6% and 6.6%, respectively). Similar result observed by (Saleh and Esmaeel , 2002) where most farmers in their study in Gaza repeated spraying the remaining solution (32%) followed by disposed from it in farm or in drainage. These practices expose water and soil to pollution. Wadi Al-Far’a farmers were the most farmers who repeated spraying (39.1%), but An-Nassariyya farmers were the most farmers who disposed the remaining solutions in the farm (31.6%). At the same time, (33.8%) of the farmers calculated the exact volume required for sparying. An-Nassariyya farmers were the least farmers who calculated the exact volume (5.3%).

A percentage of (76.7%) of the farmers used motorized sprayers drawn by a tractor. Most farmers in study performed in Gaza (Saleh and Esmaeel, 2002) used motorized sprayers drawn by a tractor. While (13.0%) of the farmers used manual backpack-type sprayers to apply agrochemicals.

(6.5%) used motorized backpack-type sprayer. Most farmers did not have any training about the sprayer use and precaution measurements. Therefore, the spraying was always associated with high risk of exposure (Figure 4.16).

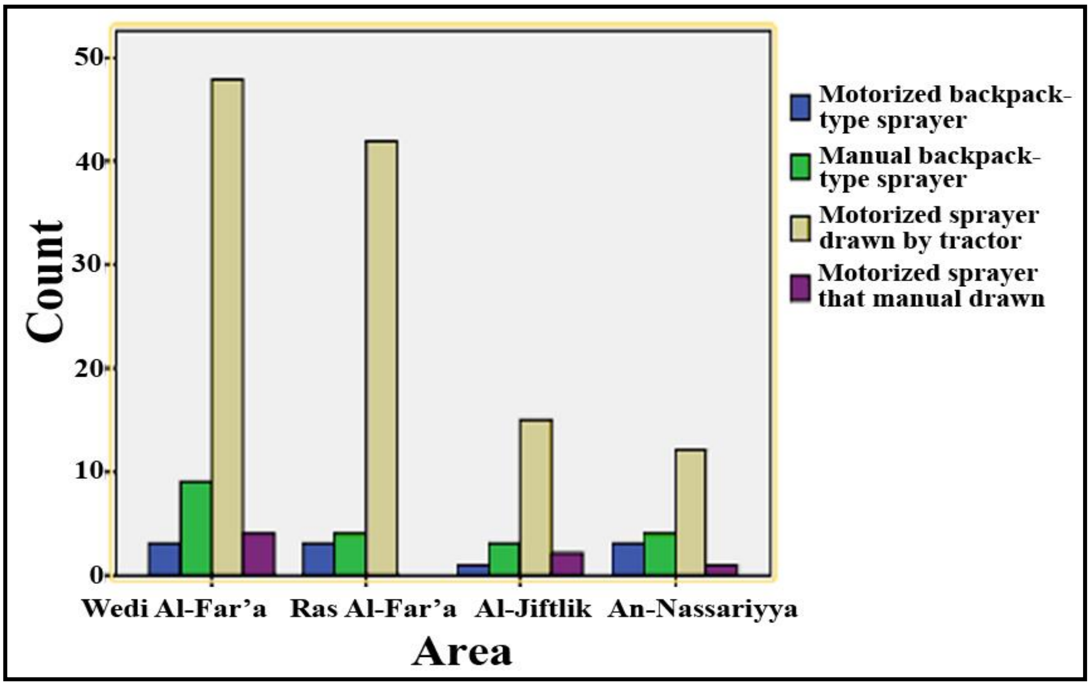


Figure (4.16): Distribution of sprayers' type that used by Al-Far'a catchment farmers

Most farmers applied large volume spray method through spraying agrochemicals (59.4 %). Some of them applied modern techniques, for example small size spraying and injection, these methods are considered safer for the environment (Figure 4.17). (7.2%) of the farmers used duster method, this method needs training because it is associated with high risk to health and environment. Farmers need more training and monitoring regarding the spraying methods used from the ministry of agriculture because the highest risk and pollution are associated with the spraying method.

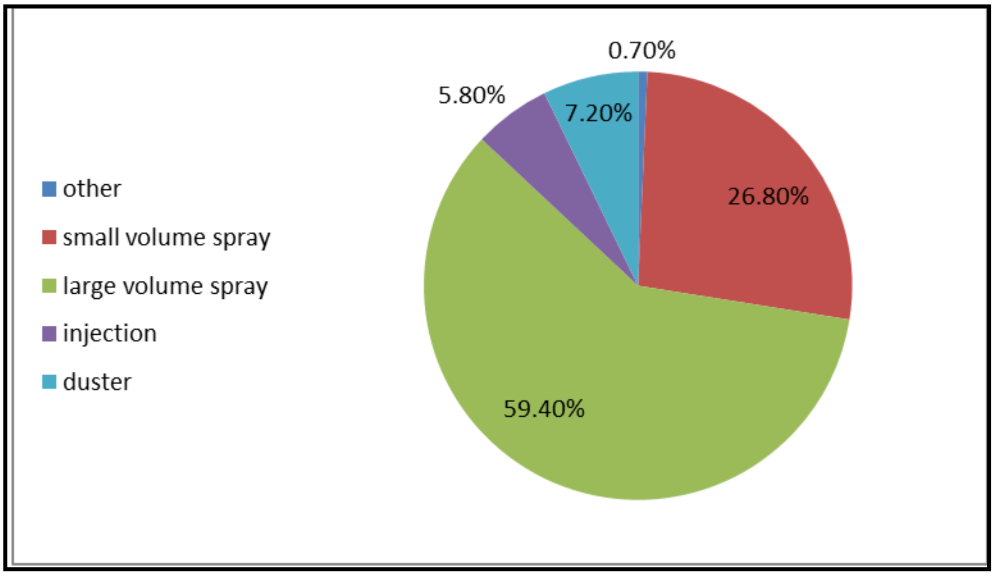


Figure (4.17): Agrochemicals spraying methods

A percentage of (59.5%) of the farmers took the pre-harvest interval (PHI) into consideration for each pesticide and did not harvest crops before it. PHI is the period of time following pesticides application on crops at which the harvest of that crop is prohibited, the harvest is considered safe for consumers after the PHI (Fouche et al., 2000). While (11.8%) harvested crops after the pesticide is dried on the crops. Whereas, (10.5%) of the farmers harvested crops in any time without considering the PHI, although they represent a small percentage, but this practices expose consumers to risk. Al-Jiftlik farmers were the most farmers who harvested crops in any time.

Illiterate farmers were the most who kept in mind the PHI period for each pesticide and did not harvest crops before it (75.0%), followed by farmers who finished secondary school, had university degree, finished primary school and passed preparatory level. While farmers who hold a university degree were the most farmers who harvested crops in any time after application (15.6%), although they know this practices was dangerous.

There was no relation between educational level and time of harvesting crops (P=0.796 P value of χ^2 test).

There was no relation between receiving extension service and the time of the harvest (P=0. 063 P value of χ^2 test). In the other hand, (65.3%) of the farmers who have sometime received extension service harvested crops after PHI, and (23.4%) of farmers who have never received extension service harvested after PHI, but they were the most farmers who harvested crops after two day at least (34.8%), so advisor had effect on farmers about this subjects.

4.2.4 Fourth Section: Farmers Knowledge about the Effect of Agrochemicals on Health and Environment

4.2.4.1 Toxicity symptoms

Most farmers suffered from breathlessness, chest pain and skin irritation vomit and coughing (13.5%) followed by itching (10.2%) and small number of farmers said that they suffered from dizziness, fatigue and high temperature (2.7%).

Most of these symptoms are considered to be common manifestations of acetylcholinesterase inhibition. Regarding toxicity symptoms associated with pesticides, results showed that the common self-reported toxicity symptoms among farm workers were dizziness, cold/breathlessness/chest pain, itching/skin irritation, and headache. These findings require urgent prevention, intervention, and protection from the Ministry of Health and other non-governmental organizations (Yassin et al., 2002). Similar data were reported in many studies as (Yassin et al., 2002), (Zyoud et al., 2010) and (Al FariS. 2007).

A percentage of (65.2%) of the farmers said that sometimes the symptoms are caused by the exposure of pesticides, while (22.3%) of the farmers denied that exposure to pesticides caused these symptoms. By region, the percentages of farmers who denied that reason is pesticides were the highest in Ras Al-Far'a (29.7%) and the lowest in Al-Jiftlik (6.3%).

4.2.4.2 Alternative methods used for pest control

A percentage of (46.6%) of the farmers used pesticides as the first solution to control pest, because pesticides is the easiest, cheapest and most effective method for pest control, while (25.3%) of the farmers acted according to agricultural supervisor instructions, however (21.2%) of the farmers tried to use other methods before pesticides usage. Ras Al-Far'a farmers were the most farmers who used pesticides as the first solution. (62.0%) of the illiterate farmers used pesticides as the first solution to control pest, while farmers who had finished preparatory and primary education did this practice only when the pest appeared (50.0% and 46.0% respectively). Farmers who hold university degree were the most farmers who tried to use alternatives before spraying pesticides (34.1%), at the same time, they are the least farmers who worked according to the advisor instructions (12.2%). (42.5 %) of the farmers who have received extension service followed their instructions, while (40.0%) of the farmers who have not received extension service use pesticides as the first solution.

When the respondent farmers were asked about using alternative methods to pesticides, the results showed that (40.0%) of the farmers believe that there were no alternatives to pesticides, because they thought that the usage of pesticides is the only effective solution for pest control. (15.2 %) of the farmers used pest-resistant crops, but they represent a small percentage because these kinds of crops are very expensive. Only (4.8%) of the farmers used Integrated Pest Management (IPM) technique to control pest, (Figure 4.18).

A percentage of (11.0%) of the farmers used biocontrols method as an alternative to chemical pesticides, biocontrols is a method for controlling pests by using other living organisms or animals. The remaining (14.5%) of the farmers do not know any alternatives to pesticides, although there is an existence of agricultural activities guidance, agricultural extension service and agricultural brochures, they were not sufficient and effective. Pest-resistant cropa were most used by Ras Al-Far'a farmers (21.7%) and they were not planted in An-Nassariyya (Figure 4.18).

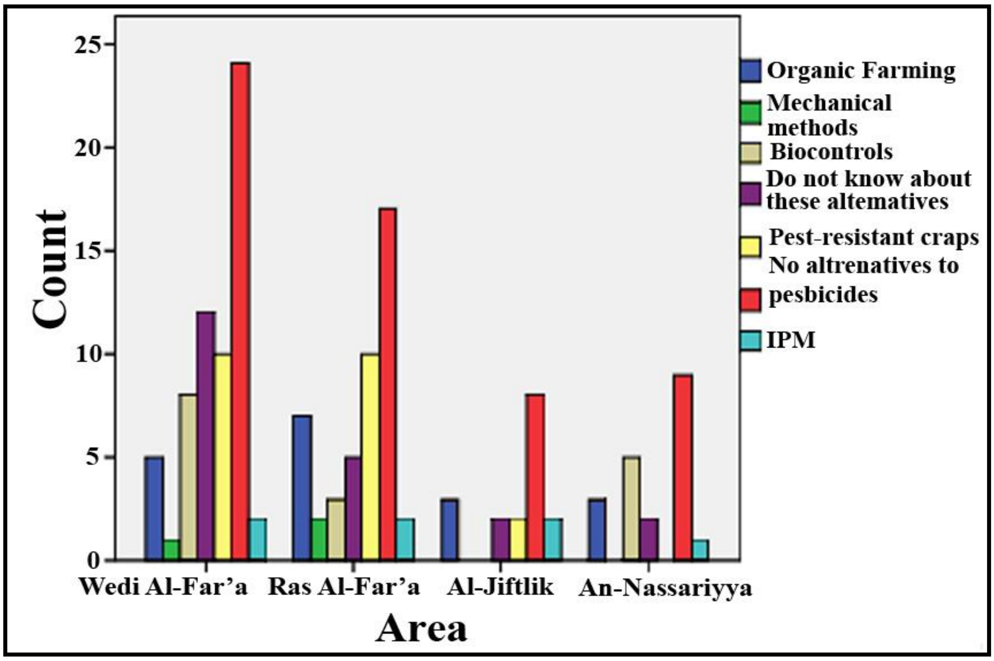


Figure (4.18): Alternative methods of chemical pesticides to pest control.

Wadi Al-Far'a farmers was the least farmers who used IPM (3.2%), farmers in Al-Jiftlik did not use mechanical methods and biocontrols as alternatives to chemical pesticides (0%).

Farmers who had university degree were the least farmers believing that there were no alternative to pesticides (22.5%) and they tried to apply organic farming (22.5%). Illiterate farmers never tried to use IPM, organic farming and bicontrols as alternatives to pesticides (0%), Illiterate farmers were the most who said that there was no alternative methods to pesticides (75.0%). While farmers who had finished secondary and preparatory school tried to use bicontrol and pest-resistant crops (11.9% and 23.8%, respectively). There was no relation between educational level and alternative methods (P=0.388, P value of χ^2 test). (44.0 %) of farmers who have received agricultural extension service said that there were no alternative methods to pesticides and (16.0%) of them used organic farming, while (4.0%) of them did not know any alternatives to pesticides. (33.3%) of the farmers who have never received agricultural extension service said that there were no alternative methods to pesticides. There was no relation between education level and receiving agricultural extension service (P=084, P value of χ^2 test). Farmers who have received agricultural extension service were the most farmers who used biocontrol and pest-resistant crops. Farmers need more training programs to increase awareness about the benefits for using alternative methods to pesticides.

4.2.4.3 Perception about the Environmental Impact of agrochemicals:

Table (4.15) shows that the mean value of farmers perception about some issue associated with agrochemicals (pesticides and fertilizers) effect on different environmental components. If the value is more than 1.5, so the farmers have perception about the effect of pesticide on the environmental components, or contrary if it was less than (1.5). Farmers have perception that agrochemicals may affect and pollute water resources, soil, air and animals, they think that the food produced involving using agrochemicals is not safe for the consumers, and that agrochemicals reach to ground waters. Farmers believed that agrochemicals effect on soil and water was higher than the impact on air. The perception about agrochemicals effect on ground water and the food produced by using pesticide is not safe for the consumers, had the smallest mean (1.77 and 2.10, respectively) and the highest standard deviation so there was a high amount of dispersion and uncertainty in the answers of farmers on these questions (Table 4.15)

Table (4.15): Respondents level of perception towards the impacts of the agrochemicals on the environment

Question	N	Min.	Max.	Mean	Std. Deviation
Did you discuss with the farmers in your area about agrochemicals and their impact on the environment	155	1	3	2.34	0.586
Do you think that the usage of agrochemicals may pollute the Water resources?	155	1	3	2.31	0.660
Do you think that the agrochemicals and fertilizers can reach to ground waters?	155	1	3	1.77	0.719
Do you think that the agrochemicals may accumulate in soil and effect on soil structure?	155	1	3	2.30	0.585
Do you think that the food that produced by using agrochemicals is not safe for the consumers?	155	1	3	2.10	0.700
Do you think that the agrochemicals spray may expose animals at risk?	155	1	3	2.23	0.587
During the agrochemicals spray, do you think that may be polluted air that causes health?	155	1	3	2.14	0.639
As total , Level of perception of the Al-Far'a farmers towards the impact of the agrochemicals on the environment	155	1	3	2.17	0.338

Farmers believed that agrochemicals effect on soil and water was higher than the impact on air. The perception about agrochemicals effect on ground water and the food produced by using pesticide is not safe for the consumers, had the smallest mean (1.77 and 2.10, respectively) and the highest standard deviation so there was a high amount of dispersion and uncertainty in the answers of farmers on these questions (Table 4.15).

Generally, Al-Far'a farmers have high level of perception about the impact of agrochemicals on environmental components by mean value of 2.17.

Correlation between the level of perception about the impacts of agrochemicals on the environment and some practices was tested by

Pearson’s correlation coefficient. There was not significant correlation (r= 0.038, P= .642) between farmers perception towards the impact of the agrochemicals on the environment and observing raining time before and after spraying in order to reduce run off, resulting in the reduction of agrochemicals access to water resources and ground waters. In addition, There was not significant correlation (r= 0.047, P= 0.564) between farmers perception towards impact of the agrochemicals on the environment and avoiding spraying near water sources and washing bodies and tools to reduce water pollution.

The mean of perception and knowledge on agrochemicals impact on the environment of farmers who had or not had training was not significantly different (P =0.519, P value of T test). Therefore, not necessary farmers who had training had more perception, while the mean of perception between age groups was significantly different (P = 0.029, P value of ANOVA test). The mean of perception was not significant of education level (p=0.169, P value of ANOVA test), education level did not effect on the level of perception and knowledge on pesticides impact on the environment.

The difference of the farmers perception to pesticides effects on the environment and using alternatives to pesticides was significant (p =<0.001, P value of ANOVA test), farmers interested in using alternatives before using pesticides to reduce exposing the environment to risk, there was significant difference with using safer and more natural fertilizer for example (compost and green manure) (p=0.028, P value of ANOVA test)

The mean of perception was not significant between spraying methods (p=0. 519, P value of ANOVA test). Most farmers used large volume spray method and the least ones use more modern methods with less pollution problems for example small volume spray and injection.

4.2.5 Evaluation of Irrigation Practices of Al-Far'a Catchment Farmers

4.2.5.1 Irrigation Resources and Types

The majority of the respondents irrigated their crops by drip irrigation or sprinklers irrigation. (45.4%) depend on seasons and crops types, while (34.8%) of them used drip irrigation only, because drip irrigation is better in water saving and (15.6%) of the farmers use sprinklers only, small percentage of the farmers use surface cannels (1.4%). Regionally, (95.2%) of An-Nassariyya farmers used drip irrigation and (22.0%) of Wadi Al-Far'a used sprinklers irrigation.

Wells are the main source of water used in irrigation (67.6%), (24.1%) of the farmers bought water from the owners' wells, (1.4%) of the farmers used wastewater in irrigation, although it represents a small percentage but this behavior expose consumer and environment at risk. Most farmers have one well in their farms only.

A percentage of (69.3%) of the farmers obtained most of their information about irrigation and water amount required for crops from their own experiences, while (17.4%) of the farmers asked the agricultural engineers, some of the farmers obtained their information from Ministry of Agriculture staff (7.3%). (8.2%) of Wadi Al-Far'a asked their relatives and friends, Ras Al-Far'a farmers were the most farmers who obtained their most information from agricultural engineers and radio and TV (18.8% and 6.3%, respectively).

4.2.5.2 Seasonal Frequency of Irrigation and Problems

Most farmers irrigated their farms during summer more than (12) times on average (64.1%), this is because the summer in the catchment is dry and hot, so crops need large amounts of water. (14.1%) of the farmers irrigated crops from (0- 6) times during summer. Irrigation patterns vary considerably by region, due to varying weather, soil, and cropping patterns. In winter the number of irrigation times decreased because farmers depended on rainwater for irrigation, so (54.3%) of the farmers irrigated the crops from (0 – 4) times but (18.1%) of them irrigated the crops more than (8) times. Beside that, irrigation depends on crop type. Al- Jiftlik farmers were the most farmers who watered crops because this area is drier in winter than other areas.

A percentage of (55.1%) of the farmers in the catchment reported that sometimes there was enough water in summer while (15.7%) of the farmers reported that they had enough water. (53.8%) of the farmers reported that the main problem facing water in the summer was water cost, the cost may increase in summer due to the lack of water in this season, while (18.9%) of the farmers said that they did not face irrigation problems during summer. Water shortage was a common problem in An-Nassariyya, but water salinity was a common problem in Al-Jiftlik.

In winter, most farmers said that there was sometimes enough water in winter (70.3%). (4.7%) of the farmers reported that there was not enough water. Al-Jiftlik farmers were the most farmers who said that there was not enough water in winter (11.1%), due to water scarcity in this region. (54.2%) of the farmers reported that they did not face irrigation problems during winter. Farmers in Al-Jiftlik reported that the cost of water was the most problem that faced them compared to farmers in other regions (42.1%). An-Nassariyya farmers were the most farmers who faced water pollution in winter (45.0%), because sewage is being mixed with irrigation water in winter.

4.2.5.3 Water problems in Al-Far’a Catchment

Unavailability of water throughout the years was the most common problem that faced the farmers (43.4%) in Al-Far’a catchment, the second problem that the farmers mentioned was the unequal water quotas (25.9%). (14.0%) of the farmers said that the Israeli occupation plays role in the water problems in the catchment, five wells in the catchment were utilized by Israel (Shadeed et al, 2007). Small percentage of the farmers mentioned that water pollution was a problem in the catchment (see Figure 4.19).

Al-Jiftlik farmers were the most farmers who said that Israeli occupation was one of the problems (36.8%), because wells always are threatened by the occupation and there is difficulty in obtaining licenses to drill new wells.

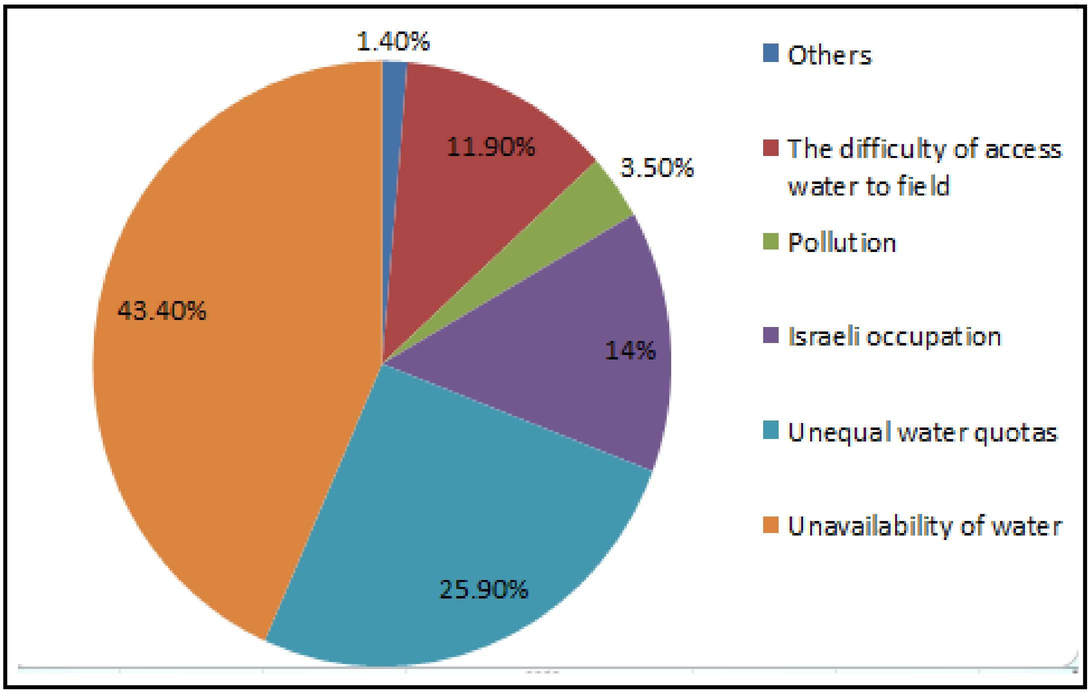


Figure (4.19): Distribution of problems face water in Al-Far'a catchment

A percentage of (23.3%) of the farmers thought that irrigation water sources in the catchment were polluted, most farmers referred that the main reason of pollution was swage (72.4%). Sewage is reported more frequently by farmers from An-Nassariyya (92.3%). Sewage mixing with water sources is the most important problem facing the catchment specially An-Nassariyya. (17.2%) of the farmers said that agrochemicals were one of the causes of pollution, in addition, An-Nassariyya and Al-Jiftlik farmers didn't think that pesticides and fertilizers was one of the causes of pollution (0%). (10.3%) of the farmers said that the dead animals and their waste can cause pollution.

4.2.5.4 Waste Water Irrigation:

A percentage of (11.1%) of the interviewed farmers used wastewater in irrigation, although a low percentage of farmers used wastewater in irrigation but this practice exposes the consumers and the environment to risk and pollution, so the Ministries of Agriculture and Environment should be concerned with this problem and take the necessary measures. Figure (4.20) shows that An-Nassariyya farmers were the most farmers who used wastewater in irrigation (50.0%), but Wadi Al- Far'a farmers were the least (3.3%). The unavailability of water was the major reason for using wastewater mentioned by farmers (52.4%), especially for Ras Al-Far'a farmers.

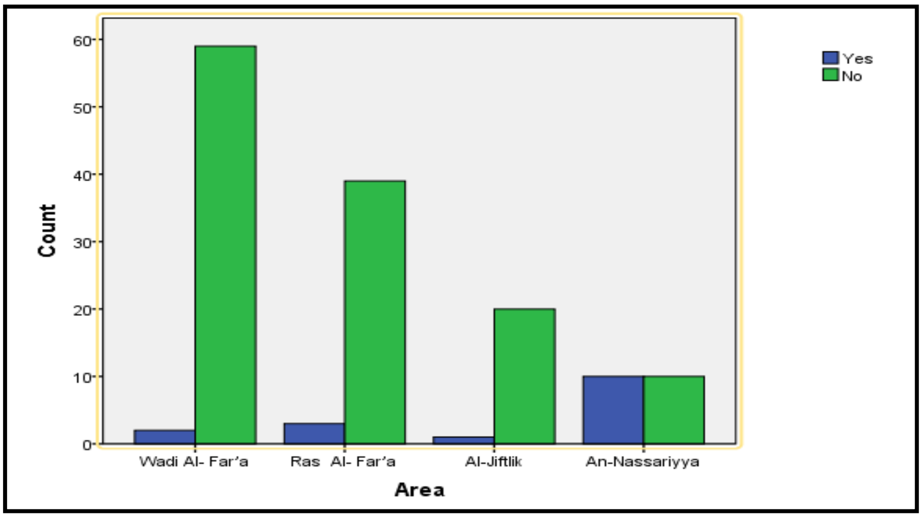


Figure (4.20): Distribution of wastewater usage regionally

Some of them believed that using wastewater in irrigation can cause soil filtration of wastewater and that the crops irrigated with wastewater were not for human consumption (9.5% and 4.8%, respectively). A small percentage (3.3%) of the farmers said that high water cost was one of the reasons for using wastewater, especially in Wadi Al-Far'a.

4.2.4.5 Irrigation Networks

A percentage of (68.9%) of the farmers constructed and set up canals based on their previous experience, while (19.6%) of the farmers said that their canals were built by agricultural angering. By region, Ras Al-Far'a farmers were the most farmers that their canals were built by agricultural engineers (33.1%). (61.1%) of the farmers always maintain and clean the canals periodically, while (3.5%) of the farmers have never cleaned them, An-Nassariyya farmers were the most farmers who have never cleaned their canals, while Wadi Al-Far'a farmers were the most farmers cleaning the canals (78.0%). (30.0%) of the farmers reported that canals have never been blocked, while (63.6%) said that they were sometimes blocked. In Al-Jiftlik, (40.0%) of the farmers reported that the canals have never been blocked by waste.

Causes of pollution from the farmers opinions were soil residues (42.5%), agrochemicals (31.3%), and dead animals (7.5 %). There were differentials by region for the cause of pollution: the percentages of the farmers who reported that sewage is a source of pollution were the highest in An-Nassariyya (31.6%) and the lowest in Wadi Al-Far'a (3.7%). Agrochemicals residues were cited by a majority respondent in Ras Al-Far'a (34.9%). Swage as a source of pollution was reported more frequently by farmers from An-Nassariyya (31.1%).

4.2.6 Relationship between Chemical Analysis and Field Questionnaire Results

Although (87.8%) of farmers used the recommended concentrations of the pesticides as recorded on the label or following the agricultural engineer instructions, the chemical results showed that there are residues of both tested pesticides in both tested crops exceeding the upper limit of the maximum allowed residue.

Field questionnaire results showed that most farmers used motorized sprayers drawn by tractor to spray agrochemicals, and most of them followed the large volume spray method when applying agrochemicals, less of them follow modern techniques on spraying. These practices can be some of the reasons for increasing the level of phosphates in soil and the considerable pesticides residues amount found in soil.

Most farmers believed that the agrochemicals could pollute the water resources, so most farmers were always used to wash their bodies and equipments at distance far away from water resources such as water wells (82.6%). (51.7%) of the farmers have never washed sprayers tools and containers in water resources and (30%) of the farmers mixed agrochemicals in irrigation water, beside that (61.1%) of farmers always maintain and clean the irrigation network periodically. Therefore, the chemical results for wells found that out of 33 wells had nitrate level exceeding the WHO guidelines for nitrate content, and one well contained phosphate level exceeding the permissible limits, while two of the wells contained COD levels higher than the permissible limits, in addition TDS, EC and pH values were within the permissible limits. Therefore, 3.5% of the farmers believe that water wells were polluted.

Chapter Five
Conclusions and Recommendations

5.1 Conclusion

Based on the obtained results, the following conclusions were observed:

5.1.1 Water

- One out of 33 wells contained nitrate level that exceeds the WHO standards for drinking water but the nitrate level in all samples did not exceed the standards for irrigation water.
- One well contained phosphate level that exceeded the EU standards for drinking water and the FAO standards for irrigation water.
- The water in the wells was very hard, while the levels of TDS, EC and pH in the wells were found within the permissible limit of the WHO standards for drinking water and the FAO standards for irrigation water.
- The level of COD in two wells and BOD level in eight wells were higher than the allowed concentration for irrigation water quality.
- Field questionnaire and chemical analysis suggested that farmers took some precautions and measures to avoid water contamination.

5.1.2 Soil

- The level of phosphate on soil samples were higher than the recommended environmental level of phosphate soil content and crops need, the highest level of phosphate was detected at the top soil. There is excessive and improper usage of phosphate fertilizers by farmers in areas that samples were collected.
- The maximum level of nitrate was found at depth (20-50 cm).The results showed that the highest concentration of nitrate was found at

soil samples that were collected from Ras Al-Far'a farms that were planted by aubergine.

- The order of heavy metal levels in soil was Fe>Zn>Ni>Cu>Pb>Cd. Heavy metals levels were lower than the maximum allowable limit of the WHO standards. Although heavy metals levels in soil were within the permissible limit, however the ongoing agricultural practices could lead to increased accumulation of heavy metals in soil.
- The results showed that there were considerable residues of the two tested pesticides (abmectin and lufenuron) in soil and the highest level was at top soil.

5.1.3 Crops

- The content of nitrogen in crops samples was lower than the maximum level for nitrates recommended by the WHO standards.
- Cucumber had more ability to accumulate nitrogen and phosphate than aubergine.
- Phosphate and nitrate were mostly accumulated in leaves than other parts of the crops.
- Heavy metals concentration differed among both crops. The order of heavy metals levels in both crops was Fe> Zn> Cu>Ni >Pb>Cd.
- Heavy metals level in crops was lower than in soil, and heavy metals were more accumulated in cucumber than in aubergine.
- In both crops, Ni and Cu levels were below permissible the WHO standards.

- The level of Cd and Pb levels (in all parts of the two crops), Fe (in leaves and shoots of the two crops) and Zn level (in aubergine shoot) were found higher than the maximum allowable limit of the WHO/FAO standards.
- Lufenuron pesticide residue in green bean exceeded the maximum permissible the EU standards.
- Abamectin pesticides residue in aubergine was found higher than MRLs set by the FAO/WHO.

5.1.4 Field questionnaire

- In general, the average level of knowledge and perception of the respondents about agrochemicals was found moderate.
- Most of the Al-Far'a farmers have finished secondary school and part of them have university degree, this enables them to accommodate new technologies in plant protection.
- Most Al-Far'a farmers did not receive any training to deal with pesticides and most agricultural programs and extension agricultural services are not effective with farmers, in addition, most farmers do not know the techniques and modern alternatives for pesticides and they consider pesticides as the best solution for them.

5.2 Recommendations

In order to decrease soil, water and plant pollution resulting from agricultural practices it is recommended to:

1. Both governmental and nongovernmental organizations have to prepare various agricultural programs and publish them through the audio-visual media to educate and guide the farmers to adopt scientific agricultural methods and manage their practices.
2. The Ministry of Agriculture have to provide farmers with training programs that aim to teach them how to deal with agro-chemicals before, during and after spraying, and guide them to adopt personal safety equipment .
3. The Ministry of Agriculture should conduct surveillance and inspection for agricultural shops that sell chemicals in order to manage agro-chemicals in the market and to prohibit the use of agrochemicals that don’t have labels.
4. More agricultural researches should be carried out that aim to solve agricultural problems and adopt modern alternative agricultural techniques, beside that, the relationship with the agricultural research centers and universities should be promoted and developed, after that; contributions should be made to implement and publish the solutions and results, then farmers should be notified of these results and support them to adopt these alternatives.

5. Farmers have to adopt effective irrigation and water management system to minimize water losses, increase the water adsorbing efficiency by the crop and reduce pollutants leaching.
6. Awareness should be increased among farmers about the adverse effects of using wastewater in irrigation on environment and health, in addition, the ministry of agriculture must make periodic visits to control wastewater usage in irrigation.

References

- Abedel-Kareem, S.M. (2005).**GIS-Based Hydrological Modeling of Semiarid Catchments (The Case of Al-Far'a Catchment)**. thesis, A-najah university ,Palestine.
- Abou Auda ,M., Abu Zinada,I. and Ali,E. (2011). **Accumulation of Heavy Metals in Crop Crops from Gaza Strip, Palestine and Study of the Physiological Parameters of Spinach Crops.** Journal of the Association of Arab Universities for Basic and Applied Sciences, Vol. 10, P. 21–27.
- Abou-Dayeh, A.G. (2006). Determination of Nitrate and Nitrite Contentin Several Vegetables in Tulkarm District. Thesis. An-Najah National University, Palestine.
- Abulude, F. O. (2005). Trace Heavy Metal Contamination of Soil and Vegetations in the Vicinity of a Livestock in Nigeria. Electronic journal of environmental ,agricultural and food chemistry , Vol. 4 (2), P. 863-870.
- Akan, J. C., Mafia, L., Mohammed, Z. and Abdulrahman, F.I. (2013). **Organophosphorus Pesticide Residues in Vegetables and Soil Samples from Alau Dam and Gongulong Agricultural Areas, Borno State, Nigeria**. International Journal of Environmental Monitoring and Analysis , Vol. 1 (2), P. 58-64.
- Al- Faris, M.(2007). **The Exposure of Farmers and Their Families to Pesticides in an Agricultural Community**. Thesis, Al- Najah University ,Palestine.

- Ali S. D. (2012). **Evaluation of Imidacloprid and Abamectin Residues in Tomato, Cucumber and Pepper by High Performance Liquid Chromatography (HPLC)**.Thesis ,A Najah National University. Palestine.
- Al-se'ad, R., Ramlawi,A., Saleh, A. (2011). **A national Survey on the Use of Agricultural Pesticides in Palestine**. International J. Environmental Studies, Vol. 68, P. 519-529.
- Amr , A. and Hadidi ,N. (2001**). Effect of Cultivar and Harvest Date on Nitrate (NO3) and Nitrite (NO2) Content of Selected Vegetables Grown Under Open Field and Greenhouse Conditions in Jordan**. Journal of Food Composition and Analysis,Vol. 14, P. 59-67.
- Agency for Toxic Substances and Disease Registry(ATSDR).(2005**). Public Health Statement. Nickel. US Department of Health and Human** Services, Public Health Service. 7440-02-0.
- Agency for Toxic Substances and Disease Registry (ATSDR). (2005). **Public Health Statement.Zinc.US Department of Health and Human** Services, Public Health Service, 7440-66-6.
- Arora, M., Kiran, B., Rani, S., Rani, A., Kaur, B., and Neeraj Mittal, N. (2008) .**Heavy Metal Accumulation in Vegetables Irrigated with Water from Different Sources.** Food Chemistry/ Elsevier Journal. Journal, Vol. 111, P. 811-815.
- Ashish,B., Neeti, K. and Himanshu, K. (2013). **Copper Toxicity: A Comprehensive Study**. Research Journal of Recent Sciences, Vol. 2, P. 58-67.

- Aviva Glaser. (2006). **Threatened Waters turning the tide on pesticide contamination**. Beyond Pesticides.
- Beegle, D. B. and Durst, P. T.(2002). **Managing Phosphorus for Crop Production**. Penn State College of Agricultural Sciences research and extension programs. U.S.
- Beyond Pesticides. (2001). **Chemical watch Factsheet, Abamectin .**Washington.
- Bosshard, E. (1992). **Abamectin**. Federal office of Public Health. Switzerland.
- California Environmental Protection Agency. (1993). **Abamectin Avert Prescription Treatment.**
- Camino-Sa´nchez ,F. J., Zafra-Go´mez, A., Ruiz-Garcı´a, J., Bermu´ dez-Peinado, R., Ballesteros O., Navalon, A. and Vı´lchez, J. L. (_2010. UNE-EN ISO/IEC 17025:2005 Accredited Method for **the Determination of 121 Pesticide Residues in Fruits and Vegetables by Gas Chromatography–Tandem Mass Spectrometry**. Journal of Food Composition and Analysis, Vol. 24, P. 427–440.
- Centre for Food Safety. 2010. **Nitrate and Nitrite in Vegetables Available in Hong Kong.** Food and Environmental Hygiene Department. Hong Kong
- Chaves, E.S., Santos,E. J., Araujo, R.G.O , Oliveira, J.V., Frescura, V.A., and Curtius, A.J. (2010). **Metals and Phosphorus Determination in Vegetable Seeds Used in the Production of**

Biodiesel by ICP OES and ICP-MS. Microchemical Journal, Vol. 96, P. 71–76.

- Chiroma, T.M., Ebewele, R.O. and Hymore, F. K. (2012**). Levels of Heavy Metals (Cu, Zn, Pb, Fe and Cr) in Bushgreen and Roselle Irrigated with Treated and Untreated Urban Sewage Water**. International Research Journal of Environment Sciences, Vol. 1 (4), P. 50-55.
- Cigulevska, O.K. (2002). **Determination of Nitrate in Food Products.** BAUE Fen Bil. Enst. Dergisi ,Vol.(4)2,P.70-73
- Clescerl, L. S, Greenberg, A. E. and D. Eaton,A.D. (1998). **Standard Methods for the Examination of Water and Wastewater**. (20th ed.) American Public Health Association(APHA).
- Deubel, A., Hofmann, B. and Orzessek, D. (2011). **Long-term effects of tillage on stratification and plant availability of phosphate and potassium in a loess chernozem**. Soil & Tillage Research. No. 117, P. 85–92. Germany.
- Divya, J. and Belagali, S.L. (2012). **Impact of chemical fertilizers on water quality in selected agricultural areas of Mysore district, Karnataka, India.** International Journal Of Environment Science, Vol. 2, No. 3.
- El-Zanaty and Associates. (2001). **Knowledge, Attitudes and Practices of Egyptian Farmers towards Water Resources**. EPIQ Water Policy Reform Program.

- Environment protection agency (EPA). **Human Health and Lead.** Retrieved from http://www.epa.gov/superfund/lead/health.htm
- Esen, E., Uslu, O. (2008). **Assessment of the effects of agricultural practices on non-point source pollution for a coastal watershed: A case study Nif Watershed, Turkey.**Ocean & Coastal Management/ Elsevier, Vol. 51, P. 601–611
- EU Pesticides databases. **Pesticides Residues**. Retrieved from http://ec.europa.eu/sanco_pesticides/public/index.cfm?event=substance.resultat&s=1
- European Food Safety Authority. (2008). **Nitrate in vegetables**. The EFSA Journal, No. 689, P. 1-79.
- European Food Safety Authority. (2008). **Conclusion Regarding the Peer Review of the Pesticide Risk Assessment of the Active Substance Lufenuron**. EFSA Scientific Report ,No. 189, P. 1-130.
- Finn, W.F., and Malluch, H.H.. (2006). **Regulation of Phosphate in Health and Disease. Johns Hopkins Advanced studied in Medicine**.
- Food and agricultural organization (FAO). (2008). **FAO Specification and Evaluation for Agricultural Pesticides / lufenuron.**
- FAO. **Water quality for agriculture**. Retrieved from http://www.fao.org/docrep/003/t0234e/t0234e01.htm
- FAO and International fertilizer industry association. (2000). **Fertilizes and their uses**, (4th ed.), Roma.
- Food and agricultural organization (FAO). (2010). **Current World Fertilizer Trends and Outlook to 2014.**

- Fouche, C., Molinar, R. Caviar, M., Joshel, C., Mullen, B. and Weber, J. (2000). **Pesticides for Specialty Crops**. Division of Agricultural and Natural Resources. Pesticides for Specialty Crops. Division of Agricultural and Natural Resources, University of California.
- Hooda, P.S., Truesdalea, V. W., Edwardsb, A. C., Withers, P. J. A., Aitken, M. N., Miller, A., Rendella, A. R. (2001). **Manuring and Fertilization Effects on Phosphorus Accumulation in Soils and Potential Environmental Implications. Advances in Environmental** Research/Elsevier, Vol. 5, Page. 13-21.
- Issa, Y., Abu Sham ,F., Nijem, K., Bjertness, E. and Kristensen, p.(2010). **Pesticide use and opportunities of exposure among farmers and their families: cross-sectional studies 1998-2006 from Hebron governorate, occupied Palestinian territory**. Environmental Health 2010, 9:63.
- Jeyaruba, T. and Thushyan, M. (2009). **The Effect of Agriculture on Quality of Groundwater: A Case Study**. Middle-East Journal of Scientific Research, Vol. 4 (2), P. 110-114.
- Kamel, A., Al-Dosary, S., Ibrahim, S. and Ahmed, M. (2006). **Degradation of the Acaricides Abamectin, Flufenoxuron and Amitrazon Saudi Arabian dates**. Food Chemistry /Elsevier, 100, P.1590–1593.
- Keith S. Dela plane. (1996) .**Pesticide Usage in the United States: History, Benefits, Risks, and Trends.** The University of Georgia, Athens, Georgia.

– Kim, M. K., Kwon, S. I., Jung, G.B., Kim, M.Y, Lee, S.B. and Lee, D. B. (2011). **Phosphorus Losses from Agricultural Soils to Surface Waters in a Small Agricultural Watershed**. Biosystems Engineering/ Elsevier Journal, Vol. 109, P. 10–14.

– Kim, T. R., Choe, B. C., Jo, S. A., Kim E. H., Hong, C. K., Jang, M.R., … Chae, Y. Z. (2011). **Evaluation of Nitrate Contents of Organic and Conventional Farming Vegetables in Korea**. International Conference on Chemical, Biological and Environment Sciences.

– Lenntech. **Phosphorus – P**. Retrieved from http://www.lenntech.com/periodic/elements/p.htm 11/2013

– Luo, L., Ma, Y., Zhang, S., Wei, D. and Zhu, Y. G.(2009).**Inventory of trace Element inputs to Agricultural soils in China**. Journal of Environmental Management, Vol. 90, P. 2524-2530.

– Luo, L., Ma, Y., Zhang, S., Wei, D.and Zhu Y.G.(2009).**Inventory of trace Element inputs to Agricultural soils in China**. Journal of Environmental Management, Vol. 90, P. 2524-2530.

– Mahvi, H., Nouri, J., Babaei , A. A. and Nabizadeh, R.(2005)**. Agricultural Activities Impact on Groundwater Nitrate Pollution**. International Journal of Environmental Science and Technology, Vol. 2, No. 1, P. 41-47 .

– Mann news. (2011, August 4**). Minister of Agriculture issued decision for banning of usage some of agricultural pesticides.** Retrieved from http://www.maannews.net/arb/ViewDetails.aspx?ID=410807t

- Medscape Medical News. (2008, December 29). **High Intake of Phosphate Food Additives May Increase Risk for and Proliferation of Lung Cancer**. Vol. 179 P. 59-68. Retrieved from http://www.easybib.com
- Mejbah Uddin, M.D., Kashem, A. and Osman,K.H .(2012). **Effect of Organic and Inorganic Fertilizers on Phyto-availability of Phosphorous to Water Spinach**. ARPN Journal of Agricultural and Biological Science, Vol. 7, No. 3.
- Miller, R. and Sonon, L. **Soil Nitrate Nitrogen KCl Extraction /Cd-Reduction Method.**
- **Ministry of Agriculture. 2011. Pesticide Manual. Palestine.** Retrieved from http://www.moa.pna.ps/bssMulti.aspx?cat_id=222
- Ministry of Environment and Sustainable Development. 1999. **Guidelines for Irrigation Water Quality**. General Notice No. 617. Mauritius
- Mirani, N., Sheikh, S. A., Shari Muhammad Nizamani, S. M. and Mahmood, N. (2013). **Effect of House Hold Processing in Removal of Lufenuron in Tomato. International Journal of Agricultural Science**. Vol. 3, P. 235-244.
- Mohamed, G.G., Saleh, M. and Ibrahim, H.M.(2012). **Monitoring of Pesticide Residues in Different Agriculture Fields Effect of Different Home Processes on the Pesticides Elimination**. International Journal of Research in Chemistry and Environment, Vol. 2 , Issue 3 ,P. 237-253.

- Mohammed, H., Sultan, S., Mahmud, N.U., Gomess,.R and Noor,S . (2011). **Heavy Metal Levels in Vegetables With Growth Stage and Plant Species Variation**. Bangladesh J. Agril. Res, Vol. 36 (4), P. 563-574
- Muchuweti, M., Birkett, J. W., Chinyanga, E., Zvauya, R., Scrimshaw, M. D. and Lester, J. N. (2006.) **Heavy Metal Content of Vegetables Irrigated with Mixture of Wastewater and Sewage Sludge in Zimbabwe: Implications for Human Health**. Agriculture, Ecosystem and Environment,Vol. 112, P.41–48.
- Mudugamuwa,I. (2013, November 28**). Agri-Ministry to Deal with High Phosphorus Levels in Vegetable Cultivations. Silence National Newspaper**. Retrieved from http://www.dailynews.lk
- Naveedullah, Hashmi, M.Z., Yu, C., HuiShen, Duan,D., Shen, C., … Chen, Y. (2013). **Risk Assessment of Heavy Metals Pollution in Agricultural Soils of Siling Reservoir Watershed in Zhejiang Province, China**. Bio Med Research International, Vol. 2013.
- Ngowia, A. V. F., Mbisea, T.J., Ijania, A. S. M., Londonb, L. and O.C. Ajayi,O.C. (2007). **Smallholder Vegetable Farmers in Northern Tanzania: Pesticides Use Practices, Perceptions, Cost and Health Effects**. Crop Protection /Elsevier journal.
- Nikolaidis, C., Mandalos, P. and Vantarakis, A. (2007). **Impact of intensive agricultural practices on drinking water quality in the EVROS Region (NE GREECE) by GIS analysis**. Environ Monit Assess

- Olowolafe, E.A. (2008). **Effects of using municipal waste as fertilizer on soil properties in Jos area, Nigeria.** Resources, Conservation and Recycling, No. 52, P. 1266–1270.
- Onder1, S., Dursun, S., Gezgin, S. and Demirbas, A. (2006). **Determination of Heavy Metal Pollution in Grass and Soil of City Centre Green Areas (Konya, Turkey).** Polish Journal of Environmental Studies, Vol. 16, No. 1, P. 145-154.
- Opaluwa, O. Da., Aremu, M. Oa., Ogbo, L. Ob, Abiola, K. Ab., Odiba, I. Ec., Abubakar, M. Ma. and Nweze, N.Od.(2012). **Heavy metal concentrations in soils, plant leaves and crops grown around dump sites in Lafia Metropolis, Nasarawa State, Nigeria.** Advances in Applied Science Research, Vol. 3, No. 2, P. 780-784.
- Oti Wilberforce, J. O. and Nwabue, F. I. (2013). **Heavy Metals Effect Due to Contamination of Vegetables from Enyigba Lead Mine in Ebonyi State, Nigeria.** Environment and Pollution, Vol. 2, No. 1,P.19-20.
- Palestinian Central Bureau of Statistics.2010. **The Palestinian Central Bureau of Statistics (PCBS) issues a press release on World Environment Day**
- Parveen, S. and Nakagoshi, N. (2001). **An Analysis of Pesticide Use for Rice Pest Management in Bangladesh**. Journal of International Development and Cooperation, Vol. 8, No. 1, P. 107–126.
- Peprah, S. (2011). **Ecological Implications of Pest Management in a Forest Agro Ecosystem: A Case Study of the Relative Toxicity of**

Some Pesticides Used for the Control of Pests in Akumadan, Ghana. Kwame Nkrumah University of Science and Technology .Kumasi.

- Prasad, S. and Chetty, A. A. (2008)**. Nitrate-N Determination in Leafy Vegetables: Study of the Effects of Cooking and Freezing.** Food Chemistry /Elsevir Journal , Vol. 106 ,P. 772–780.
- Qishlaqi, A. and Moore, F. (2007). **Statistical Analysis of Accumulation and Sources of Heavy Metals Occurrence in Agricultural Soils of Khoshk River Banks, Shiraz, Iran.** American-Eurasian J. Agric. & Environ. Sci. 2 (5), P. 565-573.
- Raha, P. **Safe Use of Pesticides**. Department Of Soil Science & Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi.
- Rattan, R. K. , Datta, S. P. , Chhonkar, P. K. , Suribabu, K. and Singh, A.K. .(2005). **Long-term Impact of Irrigation with Sewage Effluents on Heavy Metal Content in Soils, Crops and Groundwater—a case study**. Agriculture, Ecosystems and Environment, Vol. 109, P. 310-322.
- R&D Authority, Ben-Gurion University of the Negev.szeechrome **Nas Reagent (Diphenylamine Sulfonic Acid Chrcmcgene) SuiTable For Precise Determination Of Nitrates In The Presence Of Nitrites.Beer –sheva.**
- Rehman, B., SIAL, J. K., Arshad, M. and Zaman,W. (1999). **Effect of fertilizer Doses on Nitrate – Nitrogen Leaching** .International Journal of agricultural and biology, Vol. 1, No. 4.

- Rengrudkij.P and Partida, G. J. (2003). **The Effects of Humic Acid and Phosphoric Acid on Grafted Hass Avocado on Mixing Seedling Rootstock**. Actas V Congreso Mundial delAguacate, P. 395- 400.
- Pez-Bellido, L.L., oz-Romero. V and pez-Bellido, R.J .(2013).**Nitrate Accumulation in the Soil Profile: Long-Term Effects of Tillage, Rotation and N Rate in a Mediterranean Vertisol**. Soil & Tillage Research/ Elsevire. Vol, 130, P. 18–23.
- Richa, G., Gargi, G., Meenu, M., Kumar, S., Dev, P., Sanjay, K., and Sekhar, S. (2011). **Residues of Pesticides and Herbicides in Soils from Agriculture, Areas of Delhi Region.** Journal of Environment and Earth Science. Vol. 1, No. 2.
- Riley, W. J., Ortiz-Monasterio, I. and Matson, P.A. (2001)**. Nitrogen Leaching and Soil Nitrate, Nitrite, and Ammonium Levels under Irrigated Wheat in Northern Mexico.** Nutrient Cycling in Agro-ecosystems, Vol. 61, P. 223–236.
- Ritz, E., Hahn, K., Ketteler, M., Kuhlmann, M.K. and Mann J. (2012). **Phosphate Additives in Food--a Health Risk,** Dtsch Arztebl Int, Vol. 109(4), P. 49-55.
- Ryan, J., A-Stephan, G. and Abd Al- Rashid. (2003). **Manual Laboratory Analysis for Soil and Plant.** Syria : International Center for Agricultural Research in the Dry Areas.
- Saleh, A. and Esmaeel, A. (2002). **The Status of Horticulture Protection and Using Pesticides in Gaza Strip.** A-najah University Journal. Vol.16. Palestine**.**

- Saleh.Y .(2009). **Artificial Ground Water Recharge in Faria Catchment A hydrogeological study.** Thesis, A-najah University, Palestine.
- Santos, J., Santos, M., Conti, M., Santos, S. Oliveira, E. (2008**). Evaluation of Some Metals in Brazilian Coffees Cultivated during the Process of Conversion from Conventional to Organic Agriculture, Brazil.**. Food Chemistry/ Elsevier Journal, Vol. 115, P. 1405–1410.
- Savci, S. (2012)**. An Agricultural Pollutant: Chemical Fertilizer**. .International Journal of Environmental Science and Development, Vol. 3, No. 1.
- Schippera, L. A, Sparlinga, G.P., Fiska, L. M., Doddb, L. M, Powerc, I.L and Littler, R.A. (2011). **Rates of Accumulation of Cadmium and Uranium in a New Zealand Hill Farm Soil as a Result of Long-Term Use of Phosphate Fertilizer**. Agriculture, Ecosystems and Environment /Elsevier Journal, Vol. 144, P. 95–101
- Shaded, S. (2008). **Up To Date Hydrological Modeling in Arid and Semi-arid Catchment, the Case of Faria Catchment, West Bank, Palestine.** Freiburgim Breisgau, Germany**.**
- Shadeed, S., Shaheen, H., and Anan Jayyousi, A. (2007). **Management Option of Wadi Al-Far'a Base Flow**. Eleventh International Water Technology Conference, IWTC11 2.

- Shadeed, S. and Lange, J. (2010). **Rainwater Harvesting to Alleviate Water Scarcity in Dry Conditions: A Case Study in Faria Catchment, Palestine**. Water Science and Engineering, P. 132-143.
- Shomar, B., Abu Fakher, S. and Yahya, A. (2010). **Assessment of Groundwater Quality in the Gaza Strip, Palestine Using GIS Mapping.** Water Resource and Protection journal, 2. , P. 93-104.
- Soil and Plant Analysis Laboratory. (2005). **Analysis of Major, Minor, Trace Elements in soil and sediments samples with ICP-OES and ICP-MS**. University of Wisconsin . Madison.
- Soil and Plant Analysis Laboratory, University of Wisconsin. (2005). **Analysis of Major, Minor, TraceE in Plant Tissue Samples with ICP-OES and ICP-MS**. University of Wisconsin, Madison.
- Stevenson, D.E., Baumann, P. and Jackman, J.A. **Pesticides Properties that Affect Water Quality**. Texas Agri-Life Extension Service.
- Suciu, I., Cosma, C., Todică, M., Bolboacă , S.D. and Jäntschi. L. (2008). **Analysis of Soil Heavy Metal Pollution and Pattern in Central Transylvania**. International Journal of Molecular Sciences, Vol. 9, P. 434-453.
- Tharp, C. (2012). **Minimizing Pesticide Contaminated Soil Around the Home and Garden**. MSU Extension
- Tiryaki, O., Temur, C. (2010). **The Fate of Pesticide in the Environment.** Journal of Environmental Biology Science, Vol. 4(10), P. 29-38.

- Tits ,M., Elsen, A., Vandervelpen, D., Bries, J., Vandendriessche, H., Van Overtveld, K.and Diels J.(2008). **Influencing Factors on the Nitrate Residue levels in Flemish Agricultural Soils: a Statistical Analysis of 8 Years of Nitrate Measurements.** Earth and Environmental Science.
- U S. Geological Survey. **Different pesticides dominate in different land-use areas**. Retrieved from http://www.easybib.com/reference/guide/apa/website
- Vietnam: Pesticide Use Survey. **Pesticides Use in Rice Production in the Mekong Delta: Survey Field questionnaire.**
- WHO. (1996). **Permissible limits of heavy metals in soil and crops, (Genava: World Health Organization), Switzerland** .
- WHO. (2003**). Iron in Drinking-Water.** Guidelines for drinking-water quality, Vol. 2**.**
- WHO. (2003). **Total Dissolved Solids in Drinking Water**. Guidelines for drinking-water quality, (2nd ed). Vol. 2
- WHO. (2007). **Joint FAO/WHO Expert standards program codex Alimentation Commission. Geneva, Switzerland**.
- WHO .(2011)**. Nitrate and Nitrite in Drinking Water.** WHO Guidelines for Drinking-water Quality.
- Xie, W.M., Ko, K. Y., Kim, S. H, Changand, H.R., and Lee1, K.S. (2006)**. Determination of Abamectin Residue in Paprika by High-Performance Liquid Chromatography**. Korean Journal of Environmental Agriculture Vol. 25, No. 4, P. 359-364.

- Yassin, M. M, Abu Mourad, T. A, and Safi, J.M. (2002). **Knowledge, Attitude, Practice, and toxicity Symptoms Associated with Pesticide Use among Farm Workers in the Gaza Strip**. Occup Environ Med , Vol. 59, P. 387–394.
- Young, S. M, Pitawala, A. and Gunati, j. (2009). **The effect of Agricultural Practices on Chemical Quality of Water Kalaoya River Basin**. Journal of Geological Society of Sri Lanka Vol. 13, P. 97-104.
- Zalidis, G., Stamatiadis, S., Takavakoglou, V., Eskridge, K. and Misopolinos,N. (2002**). Impacts of Agricultural Practices on Soil and Water Quality in the Mediterranean Region and Proposed Assessment**. Methodology journal , Agriculture, Ecosystems and Environment, Vol. 88, P. 137–146.
- Zawiyah, S., Che Man, Y.B., Nazimah, S.A.H., Chin, C. K., Tsukamoto, Hamanyza, A.H. and Norhaizan. (2007). **Determination of Organochlorine and Pyrethroid Pesticides in Fruit and Vegetables Using SAX/PSA Clean-up Column**. Food Chemistry /Elsevir, Vol. 102, P. 98–103.
- Zhang, H., CUI, B., XIAO, R. and Hui ZHAO, H. (2010) .**Heavy Metals in Water, Soils and Crops in Riparian Wetlands in the Pearl River Estuary, South China**. International Society for Environmental Information Sciences , Annual Conference (ISEIS),P. 1344–1354.
- Zhang, W., Jiang, F. and Ou, J.(2011). **Global pesticide consumption and pollution: with China as a Focus**. Proceedings of the International

Academy of Ecology and Environmental Sciences, Vol. 1(2).P. 125-144.

- Zyoud, S. H., Sawalha, A. F., Sweileh, W. M., Awang, R., Al-Khalil, S., Al-Jabi, S.W. and Bsharat, N.M. (2010). **Knowledge and Practices of Pesticide Use among Farm Workers in the West Bank, Palestine: Safety Implications**. Environmental Health and Preventive Medicine, Vol. 15 (4), P. 252–261

Appendixes

Appendix A: Pesticides that permitted for using in agriculture in Palestine (MOA, 2011)

Insecticides, Acaricides and Nematicides

Brand Name	Pesticide Formulation	Content a.i.	Generic Name
EVISECT S	SP	50%	THIOCYCLAM HYDROGENE OXALATE
ACRIMITE	SC	550g/L	FENBUTATIN OXIDE
ALSYSTIN	WP	25%	TRIFLUMURON
INSEGAR	WG	25%	FENOXYCARB
IPON	SG	20%	DINOTEFURAN
APLORD	SC	250 g/L	BUPROFEZIN
APOLLO	SC	50 g/L	CLOFENTEZINE
ATTABRON	EC	50 g/L	CHLORFLUAZURON
AGROCELHONE	EC	92%	DICHLOROPROPENE
AGRIRON	EC	18 g/L	ABAMECTIN
AVANT	SC	150 g/L	INDOXACARB
ACTARA	SC	240 g/L	THIAMETHOXAM
ACREMAKTEN	EC	18 g/L	ABAMECTIN
ANNIVERS	CS	50 g/L	HALFENPROX
OBERON	SC	240 g/L	SPIROMESIFEN
X MITE	SC	150 g/L	ACEQUINOCYL
IMAXI	SC	350 g/l	IMIDACLOPRID
EOS	OL	0.99	MINERAL OIL
BAYTHROID	EC	50 g/L	CYFLUTHRIN
PRIDE	SC	200 g/L	FENAZAQUIN
PEROPAL	WP	25%	AZOCYCLOTIN
PROCLAIM	EC	19.20 g/L	EMAMECTIN BENZOATE
PROMECTIN	EC	18 g/L	ABAMECTIN
BAKTEN	EC	18 g/L	ABAMECTIN
BUTRIX	SC	550 g/l	FENBUTATIN OXIDE
POLADO	SC	500 g/L	DIAFENTHIURON
POLO 25	SC	250 g/L	DIAFENTHIURON
POLO 50	SC	500 g/L	DIAFENTHIURON
BIOMACTIN	EC	18 g/L	ABAMECTIN
TIGER	EC	100 g/L	PYRIPROXYFEN
TRACER ULTRA	SC	120 g/L	SPINOSAD
TARSIP	EC	200 g/L	CYPERMETHRIN
TROOPER	WP	75%	CYROMAZINE
TREBON	EC	300 g/L	ETOFENPROX
TRIGARD	WP	75%	CYROMAZINE
TLON 2	L	94%	DICHLOROPROPENE
TORK	SC	550 g/L	FENBUTATIN OXIDE
TOKUTHION	EC	500 g/L	PROTHIOFOS
TONTAR	SC	550 g/L	FENBUTATIN OXIDE
TITAN 20	EC	200 g/L	CYPERMETHRIN

TEDION	EC	80 g/L	TETRADIFON
DECIS	EC	25 g/L	DELTAMETHRIN
DIMETHOATE	EC	400g/L	DIMETHOATE
DEMOL	OL	98%	PARFFINIC OIL
DIMILIN	WP	25%	DIFLUBENZURON
RAGBY SUPER	CS	200 g/L	CADUSAFOS
RUNER	SC	240 g/L	METHOXYFENOZIDE
ROGOR 40	EC	400 g/L	DIMETHOATE
RUFAST	EW	75%	ACRINATHRIN
ROMACTEN	EC	18 g/L	ABAMECTIN
RIMON	EC	100 g/L	NOVALURON
SPIDER	SC	110 g/L	ETOXAZOL
SAFSAN 1015	GB	15%	SODIUM FLUOSILICATE
SAFSAN 515	GB	15%	SODIUM FLUOSILICATE
CYMBUSH 10	EC	100 g/L	CYPERMETHRIN
CIMESHUPAR	EC	200 g/L	CYPERMETHRIN
SUPERTHION	EC	420 g/L	METHIDATHION
SUPERACIDE	EC	420 g/L	METHIDATHION
SIPERIN 10	EC	100 g/L	CYPERMETHRIN
SIPERIN 20	EC	200 g/L	CYPERMETHRIN
CITRONA OL	OL	82%	SUMMER OIL
SAF-T-SIDE	E	80%	PETROLEUM OIL
RALOTHRIN	EC	100 g/L	CYPERMETHRIN
SUFA	SC	520 g/L	SULPHUR
FLORMAIT	SC	240 g/L	BIFENAZATE
VERTIMEC	EC	18 g/L	ABAMECTIN
VERKOTEL	EC	18 g/L	ABAMECTIN
VIROTAR OL	OL	80%	SUMMER OIL
CASCADE	SL	50 g/L	FLUFENOXURON
CALYBSO	SC	480 g/L	THIACLOPRID
KING BO	EC	(0.2% + 0.4%)w/w	OXYMATRINE + PROSULER
KANDOR	EC	91.70%	DICHLOROPROPENE
CONFIDOR	SC	350 g/L	IMIDACLOPRID
COPRA	EC	100 g/L	PYRIPROXYFEN
KODKOD	SC	350 g/l	IMIDACLOPRID
COMODOR	SC	350 g/L	IMIDACLOPRID
KUNG FU	CS	50 g/L	LAMBDA CYHALOTHRIN
KOHINOR	SC	350 g/L	IMIDACLOPRID
KESHET	EC	25 g/L	DELTAMETHRIN
LAMDEX	EC	50 g/L	LAMBDA CYHALOTHRIN
LEVANOLA	OL	82%	SUMMER OIL
MATCH	EC	50 g/L	LUFENURON
MITECLEAN	SC	100 g/L	PYRIMIDIFEN
MASAI	WP	20%	TEBUFENPYRAD
MOSBLAN	SL	200 g/L	ACETAMIPRID
MOLIT	SC	150 g/L	TEFLUBENZURON
MELPNOK	EC	9.3 g/L	MILBEMECTIN

NEEMACOR 10	GR	10%	FENAMIPHOS
NEEMACOR 400	EC	400 g/L	FENAMIPHOS
NEROLA	OL	99.25%	SUMMER OIL
NERON 250	EC	250 g/L	BROMOPROPYLATE

Fungicides and Bactericides

Brand Name	Pesticide Formulation	Content a.i.	Generic Name
ABEIR	SC	250g/L	QUINOXYFEN
ORTIVA TOP	Sc	(200+125) g/L	AZOXYSTROBIN + DIFENOCONAZOLE
INDAR	EC	50g/L	FENBUCONAZOLE
EUPAREN MULTI	Wp	50%	TOLYLFLUANID
OFIR	EC	100 g/L	PENCONAZOLE
OFIR 2000	EW	200 g/L	PENCONAZOLE
OCTAV	WP	50%	PROCHLORAZ MANGANESE
ALIETTE	Wp	80%	FOSETHYL ALUMINIUM
AMCO – M	WP	70%	THIOPHANATE METHYL
AMISTAR	SC	250 g/L	AZOXYSTROBIN
ANTRACOL	WP	70%	PROPINEB
OHAIO	SC	500 g/L	FLUAZINAM
AQ 10	Wg	5*109	AMPELOMYCES QUISQUALIS
INDANIL	Wg	50%	CYMOXANIL
BAYFIDAN	EC	250 g/L	TRIADIMENOL
BAYCOR	WP	25%	BITERTANOL
PARASOL	WP	77%	COPPER HYDROXIDE
PRUPICA	SC	400 g/L	MEPANIPYRIM
PREVICUR	Sl	722 g/L	PROPAMOCARP HCL
BAZAMID	GR	98%	DAZOMET
PLANTAX	WP	75%	OXYCARBOXIN
BLU SHILD	WP	77%	COPPER HYDROXIDE
BLEKIOT	WP	40%	IMINOCTADINE TRIS
PUNCH 40	EC	400 g/L	FLUSILAZOLE
PENCUR	SC	250 g/L	PENCYCURON
BOGIRON	EC	250 g/L	DIFENOCONAZOLE
BORDOZOL	WP	80%	COPPER SULPHATE
BUSAN	EC	300 g/L	TCMTB
POLAR	WG	50%	POLYOXIN-AL
POLIRAM DF	WG	70%	METIRAM
PYRUS	SL	300 g/L	PYRIMETHANIL
BAVISTIN	WG	50%	CARBENDAZIM
TALOSINT	SL	50%	CU BIET
TERRACLOR	WP	75%	QUINTOZENE (PCNB)
TOPENKO	EC	100 g/L	PENCONAZOLE
TELEM	SC	410 g/L	FLUTOLANIL

THAIOVIT	WG	80%	SULPHUR
GAFRIBK	DP	70%	SULPHUR
GAFRITP	WP	80%	SULPHUR
GOFRITHAR	SC	825 g/L	SULPHUR
HOSEN	SC	125 g/L	FLUTRIAFOL
DELSENE	WP	50%	CARBENDAZIM
DELAN	SC	500g/L	DITHIANON
DENGLE	WG	50%	DIMETHOMORPH
DOTAN - PROPLANT	SL	722 g/L	PROPAMOCARP HCL
DIFENDO	EC	0.25	DIFENOCONAZOLE
RALLY	EW	200 g/L	MYCLOBUTANIL
RIDOMIL GOLD – CU PLUS	WP	40 + 2.5 %	COPPER OXYCHLORIDE + MEFENOXAM
RIDOMIL GOLD NOZL	SL	480 g/l	MEFENOXAM
RUBIGAN	EC	120 g/L	FENARIMOL
ROOT PRO	DP	5*10^7	TRICHODERMA HARZIANUM
RODION	SC	500 g/L	IPRODIONE
ROVRAL NOZEL	SC	500 g/L	IPRODIONE
ROVRAL 50	WP	50%	IPRODIONE
RITREAP	EW	5%	CYFLUFENAMID
RISOLEX 50	WP	50%	TOLCLOFOS METHYL
RESEC	SC	250+250 g/L	CARBENDAZIM + DIETHOFENCARB
REVUS	SC	250g/ L	MANDIPROPAMID
SAPAROL	EC	190 g/L	TRIFORINE
SPORTACK	EC	450 g/L	PROCHLORAZ
STERNER	WP	20%	OXOLINIC ACID
STROBY	WG	50%	KRESOXIM METHYL
SPHINX	SC	500 g/L	DIMETHOMORPH
SCORE	EC	250 g/L	DIFENOCONAZOLE
SKIPPER	EC	250 g/l	DIFENOCONAZOLE
CELEST	FC	100 g/L	FLUDIOXONIL
SALFO RON	SC	720 g/L	SULPHUR
SALFO LE	SL	650 g/L	SULPHER
SWITCH	WG	37.5 + 25 %	CYPRODINIL + FLUDIOXONIL
SIGNUM	WG	(6.7 + 26.7) %	PYRACLOSTROBIN + BOSCALID
CHAMPION	WP	77%	COPPER HYDROXIDE
SHAVIT	EC	250 g/L	TRIADIMENOL
SHEMER	WG	56%	METSCHNIKOWIA FRUCTICOLA
SUFA	SC	720 g/L	SULPHUR

TELDOR	SC	500 g/L	FENHEXAMID
OMER	EC	100 g/L	PENCONAZOLE
VECTRA	SC	100 g/L	BROMUCONAZOLE
FLINT	WG	50%	TRIFLOXYSTROBIN
FUNGURAN	WP	77%	COPPER HYDROXIDE
FYTEN	WG	45%	CYMOXANIL
CABRIO	EC	40 g/L + 72 g/L	PYRACLOSTROBIN + DIMETHOMORPH
COPPER SULPHATE	WP	98%	COPPER SULPHATE
KALIGREN	SP	80%	POTASSIUM BICARBONATE
CANON	SL	780 g/L	POTASSIUM PHOSPHITE
CUPRO ANTRACOL	WP	17.5+37%	PROPINEB + COPPER OXYCHLORDE
CURZATE	WG	60%	CYMOXANIL
KOCIDE 101	WP	77%	COPPER HYDROXIDE
KOCIDE 2000	WG	53.80%	COPPER HYDROXIDE
KOCIDE DF	WG	61.40%	COPPER HYDROXIDE
COLLIS	SC	100 g/L+ 200 g/L	KRESOXIM METHYL + BOSCALID
KUMULUS	WG	80%	SULPHUR
CONSENTO	SC	375 g/L+ 75 g/L	PROPAMOCARB HCL + FENAMIDONE
CUNEB FORTE	SL	780 g/L	POTASSIUM PHOSPHITE
MARIT	WP	12.50%	DINICONAZOLE
MILVAN	WP	10%	POLYOXIN B
MONCEREN	SC	250 g/L	PENCYCURON
MITHOS	SC	300 g/L	PYRIMETHANIL
MIRAGE 45	EC	450 g/L	PROCHLORAZ
MICROTHIOL	WG	80%	SULPHUR
MELODY DUO	WP	5.5% + 61.25%	IPROVALICARB+ PROPINEB
NAT 35	SL	340 g/L	POTASSIUM SALT FATTY ACID
NAMROD	EC	250 g/L	BUPIRIMATE
HALOGAFRIT	SC	700 g/L	SULPHUR

Herbicides

Brand Name	Pesticide Formulation	Content a.i.	Generic Name
AGREIN 500	SC	500 g/L	TERBUTRYNE
AMITREX	SC	500 g/L	AMETRYNE
EXPRESS	WG	75%	TRIBENURON METHYL
AMBER	WG	75%	TRIASULFURON
AMIGAN 65	WP	25+40%	TERBUTRYNE + AMETRYNE
OUST 75	WG	75%	SULFOMETURON METHYL
OXYGAL	EC	240 g/L	OXYFLUORFEN
AFLON	SC	500 g/L	LINURON
AMINOBAR	SP	96.90%	2,4-D (AS AMINO SALT)
AURORA	WG	40%	CARFENTRAZONE ETHYL
ALBUR SUPER	EC	335 g/L	2,4-D
BAZAGRAN	SL	480 g/l	BENTAZONE
PURSUIT	SL	100 g/L	IMAZETHAPYR
PROMETREX	SC	500g/L	PROMETRYNE
PROMETRON	SC	500 g/L	PROMETRYNE
PROMEGARD	SC	500 g/L	PROMETRYNE
PANTERA	EC	40 g/L	QUIZALOFOP-P- TEFURYL
PILAROUND	SL	480 g/L	GLYPHOSATE ISOPROPY AMINE SALT
BASTA 20	SL	200 g/L	GLUFOSINATE AMMONIUM
PULSAR	EC	40 g/L	IMAZAMOX
BUSTER	SL	200 g/L	GLUFOSINATE AMMONIUM
BENEFEX 18	EC	180 g/L	BENFLURALIN
BORAL	SC	480 g/L	SULFENTRAZONE
PUMA SUPER NEW	EW	69+18.8 g/L	FENOXAPROP –P- ETHYL + MEFENPYRDIETHYL
BEDOZOL TL	SL	220 + 250 g/L	AMMONOIUM THIOCYANATE + AMINOTRIAZOLE
PYRAMIN	WG	65%	CHLORIDAZON
TERGA SUPER	EC	50 g/L	QUIZALOFOP-P- ETHYL
TERBUTREX	SC	500 g/L	TERBUTRYNE
TREFLAN	EC	480 g/L	TRIFLURALIN
TRIFLUREX	EC	480 g/L	TRIFLURALIN
TRABLE	EC	480 g/L	TRICLOPYR
TOPIK 100	EC	25 g/L + 100 g/L	CLOQUINTOCET MEXYL + CLODINAFOP PROPARGYL
CHALLENGE	SC	600 g/L	ACLONIFEN
TORDON 101	EC	102 g/L + 396 g/L	PICLORAM + 2,4-D (AS AMINO SALT)
TOSTAR	WG	75%	SULFOMETURON METHYL
TOMAHAWK	EC	200 g/L	FLUROXYPYR
TIARA	WG	60%	FLUFENACET

TITUS	WG	25%	RIMSULFURON METHYL
TAIFUN	SL	480 g/L	GLYPHOSATE ISOPROPY AMINE SALT
GALOOP	SL	480 g/L	GLYPHOSATE ISOPROPYL AMINE SALT
GARLON	EC	480 g/L	TRICLOPYR
GALANT SUPER	EC	104 g/L	HALOXYFOPR METHYL
GALEON	EC	240 g/L	OXYFLUORFEN
TOP-GAN	EC	25 g/L+ 100 g/L	CLOQUINTOCET MEXYL + CLODINAFOP PROPARGYL
GALIGAN	EC	240 g/L	OXYFLUORFEN
GLYPHOGAN	SL	480 g/L	GLYPHOSATE ISOPROPY AMINE SALT
GLYPHOS	SL	480 g/L	GLYPHOSATE ISOPROPY AMINE SALT
GLEFON	SL	480 g/L	GLYPHOSATE ISOPROPY AMINE SALT
GOAL GR	GR	2%	OXYFLUORFEN
GOAL FN	EC	238 g/L	OXYFLUORFEN
DROPP ULTRA	SC	60+ 120 g/L	DIURON+THIDIAZURON
DERBY	SC	75+100 g/L	FLORASULAM+FLUMETSULAM
DUAL S. GOLD	EC	915 g/L	METOLACHLOR-S
DOSANEX 80	WP	80%	METOXURON
DIQUALON	EC	200 g/l	DIQUAT
RAFT	SC	400 g/L	OXADIARGYL
ROUNDUP	SL	480 g/L	GLYPHOSATE ISOPROPY AMINE SALT
RONDOPAZ	SL	480 g/L	GLYPHOSATE ISOPROPY AMINE SALT
REGALON	EC	200 g/L	DIQUAT
RACER	EC	250 g/L	FLUROCHLORIDONE
ZOHAR OC-6	SL	500 g/L	ANIONICS&NONIONICS
SANAFEN SUPER	EC	350 g/L	2,4-D ISO OCTYL ESTER
STARANE	EC	200 g/L	FLUROXYPYR
STRIKE	WP	50%	FLUMIOXAZIN
STRIPTEASE	SC	60+120 g/L	DIURON+THIDIAZURON
STOMP	EC	330 g/L	PENDIMETHALIN
STAPLE	SP	85%	PYRITHIOBAC SODIUM
SPOTLIGHT	EW	60 g/L	CARFETRAZONE ETHYL
SELECT SUPR	EC	116 g/L	CLETHODIM
SENPSHOT	GR	0.5% + 2%	ISOXABEN + TRIFLURALIN
SENCOR 70	WG	70%	METRIBUZIN
SURFLAN	SL	480 g/L	ORYZALIN
SONALAN	EC	333 g/L	ETHALFLURALIN
SHUGN	EC	100 g/L	PROPAQUIZAFOP

FLEX	SL	250 g/L	FOMESAFEN
FLOREN	EC	480 g/L	TRIFLURALIN
FOCUS ULTRA	EC	100 g/L	CYCLOXYDIM
FUZILADE FROTY	EC	150 g/L	FLUAZIFOP –P- BUTYL
CADRE	SL	240 g/L	IMAZAPIC
COTTOGAN	SC	500 g/L	FLUOMETURON
COTTOLINT	SC	500 g/L	FLUOMETURON
QUARTZ	SC	500 g/L	DIFLUFENICAN
COMMAND	CS	360 g/L	CLOMAZONE
LENTAGRAN	EC	600 g/L	PYRIDATE
LENTMOL D	EW	480 g/L	2,4-D ISO OCTYLESTER
LOABORD 10	EC	100 g/L	QUIZALOFOP-P- ETHYL
LOTUSE	EC	200 g/L	CINIDON ETHYL
LONTRLE	EC	100 g/L	CLOPYRALID
LINOR	SC	410 g/L	LINURON
LINUREX	SC	500 g/L	LINURON
MAG 18	SL	230 g/L	MAGNESIUM CHLORATE
HOSAR	WG	5% +15%	IODOSULFURON METHYL SODIUM + MEFENPYR DIETHYL

Molluscicides

Brand Name	**Pesticide Formulation**	**Content a.i.**	**Generic Name**
ESKAR GO	GB	6%	METALDEHYDE
METAZON	GB	5%	METALDEHYDE
METAZON 200	GB	5%	METALDEHYDE

Rodenticides

Brand Name	**Pesticide Formulation**	**Content a.i.**	**Generic Name**
BRODITOP PASTA	RB	0.01%	BRODIFACOUM
RATIOLON PELLETS	PE	0.01%	BROMADIOLONE
RATIMON	SL	0.25%	BROMADIOLONE
RATIMON G	GB	0.01%	BROMADIOLONE
RATIMON L	CB	2.5 g/L	BROMADIOLONE
RACUMIN 57	CB	0.75%	COUMATETRALYL
RACUMIN PASTE	RB	0.04%	COUMATETRALYL

Appendix B: Field Questionnaire

تقييم الممارسات الزراعية وأثرها على المياه والتربة في حوض الفارعة

- **يهدف هذا الاستبيان إلى دراسة تقييم الممارسات الزراعية وأثرها على التربة والمياه في حوض الفارعة، وهذا الاستبيان لغرض البحث العلمي فقط وذلك لاستكمال رسالة الماجستير - دراسات عليا – جامعة النجاح الوطنية**
- **يرجى الإجابة عن الأسئلة التالية بصدق وموضوعية وفي حالة انطباق أكثر من خيار ضع دائرة حول كل ما ينطبق.**

خصائص اجتماعية:

1. **الجنس:** **أ. ذكر** **ب. أنثى**
2. **العمر:** أ. أقل من 18 سنة ب. 18-40 سنة ج. أكثر من 40 سنة
3. **المستوى العلمي:** أ.أمي ب. ابتدائي ج. أعدادي د.ثانوي هـ.جامعي
4. **مدخن:** أ.نعم ب. لا
5. **طبيعة العمل** أ.مزارع ب.مزارع وموظف في قطاع عام ج. مزارع وموظف قي قطاع خاص
6. **طبيعة الأرض التي تعمل فيها من حيث الملكية** أ.ملك ب.استئجار ج.عامل فيها
7. **..العوامل التي تنظر إليها عند زراعة محصول جديد** أ.طلب السوق ب.كمية المياه التي يحتاجها وتوفرها ج.مساحة الأرض د.حالة التربة ه.تكلفة الاحتياجات اللازمة خلال الزراعة ز.محصول لتغذية الماشية ح.الجهد الذي بتطلبه وعدد العمال ط.إذا كان يحتاج إلى بيت بلاستكي ق.غير ذلك ،اذكر--------

أولا: مدى معرفة المزارع بأسس استخدام المبيد والسماد بأنواعه :

1. هل يوجد مرشد زراعي يزور مزرعتك كل فترة؟	**أ. دائما ب. أحيانا ج. أبدا**
2. هل تستخدم المبيدات؟	أ. نعم ب. لا، السبب-------------
3. الفترة الزمنية (بالسنة) وأنت تستخدم المبيدات؟	أ. أقل من سنتين ب. 2-5 سنوات ج.أكثر من 5 سنوات
4. من يقوم برش المبيدات بمزرعتك ؟	أ.احد من أفراد الأسرة ب.أنت بنفسك ج.شخص مكلف من قبل وزارة الزراعة د.شخص مستأجر متخصص في رش المبيدات ه. غير ذلك،اذكر ----------------------
5. مصدر معلوماتك لتحدد كمية السماد أو المبيد التي يحتاجها النبات	أ. مهندس زراعي ب.موظفي وزارة الزراعة ج.الجمعيات الزراعية د. التلفاز والراديو ه. الأقارب والأصدقاء و .الخبرة العملية الشخصية ز.المزارعين ح.غير ذلك،اذكر---
6. هل خضعت لدورة تدريبية حول استخدام المبيدات أو الأسمدة؟	أ. نعم ب. لا
7. عند تحضير مبيد تضع تركيزه حسب...	أ. التعليمات على العبوة أو تعليمات المهندس الزراعي ب. أكثر من التركيز الموصى ج. أقل من التركيز الموصى
8. إذا كانت إجابتك أكثر من التركيز الموصى ما سبب ذلك	أ. زيادة فعالية المبيد ب. بناءا على تعليمات المورد ج. بسبب زيادة الآفات والأعشاب الضارة د. لان ما حولي من المزارعين يقومون بذلك ه.غير ذلك،اذكر--------------------------
9. من أين تشتري المبيد والأسمدة عادة	
10. هل صادف وأن اشتريت مبيد أو سماد لا يوجد عليه طابع وتعليمات مكتوبة على العلبة؟	أ. دائما ب. أحيانا ج. أبدا
11. العوامل التي تنظر إليها عند شراء المبيد أو السماد	أ.سعر المبيد أو السماد ب.توفر المعلومات الكافية لطريقة استخدامه ج.أثره على البيئة والصحة د.ألا يكون من المبيد ممنوع استخدامه في فلسطين ه..فعالية المنتج و. غير ذلك اذكر--------
12. هل قمت بخلط أكثر من مبيد معا ؟	أ. نعم ب.لا
13. إذا كانت إجابتك نعم ما سبب الذي دعاك للخلط .	أ. بناءا على تعليمات اللاصق على العبوة ب. زيادة في كفاءة المبيد ج. غير واثق من نوعية المبيد د. بناءا على تعليمات المهندس الزراعي ه. لان ما حولي من المزارعين يقومون بذلك ط.غير ذلك ،اذكر ----------------------
14. هل تستخدم الأسمدة بأنواعها.	أ.نعم ب. لا

15. إذا كنت تستخدم الأسمدة، ما طبيعة الأسمدة التي تستخدمها ؟ أ. أسمدة كيماوية فقط ب. روث الحيوانات ج.أسمدة كيماوية وروث الحيوانات فقط د. غير ذلك ،اذكر ----

16. إذا كنت لا تستخدم الأسمدة بأنواعها ترجع السبب إلى .
أ. غير متوفرة
ب. كمية المياه المستخدمة للري غير متوفرة
ج. تؤدي إلى تدهور التربة
د. زيادة في عدد الآفات ونمو الأعشاب
ه. غير ضرورية في الزراعة
و. لأسباب مادية
ز. غير ذلك، اذكر ----------------------

17. أي من العوامل التالية تنظر إليها عن إضافة السماد. أ.نوع النبات ب.نظام الري ج.طريقة التسميد ه.نوع التربة و.طبيعة الزراعة(مغلق الأرض أو مفتوحة ز.حجم ح.غير ذلك اذكر --------

18. أ. هل استخدمت احد من الأحماض العضوية الأمنية كحمض الهيوميك (humic acid)(اوبتيك)؟ أنعم ب.لا

19. هل تستخدم حمض الفوسفوريك كسماد؟ أ.نعم ب.لا

20. هل استخدمت إحدى هذه الأسمدة ؟
أ. الأسمدة الخضراء ب. أسمدة المغذيات الدقيقة
ج. الأسمدة الميكروبية د. الجير
ه.الكمبوست

ثانيا: تقييم تعامل المزارعين مع المبيدات والأسمدة قبل وأثناء وبعد عملية الرش:

1.الأسلوب الذي تتبعه عادة عند رش المبيد أو السماد.	**أ.الرش بالحجم الكبير ه.الحقن**	**ب.الرش بالحجم الصغير و.التعفير**	**ج.الحقن د. التدخين ز.غير ذلك، اذكر -----**
2.نوع آلة الرش المستعملة	أ.موتور الرش الظهري ج. موتور الرش المسحوب بالجرار ه.غير ذلك اذكر ------------		ب. آلة رش ظهرية يدوية د. موتور الرش المسحوب يدويا
3. أين تخزن المبيدات والأسمدة والأدوات الخاصة بهما عادة؟	أ. مخزن خاص بالمزرعة	ب. البيت (مخزن ، كراج، مطبخ)	ج. غير ذلك...........
4. ماذا ترتدي من الآتي عند استخدام المبيدات أو الأسمدة؟	أ. كفوف ب. طاقية ج. قناع د. حذاء خاص هـ. نظارات واقية و. لباس كامل (overall)		
5.هل تراعي تساقط الأمطار قبل وبعد عملية الرش ؟	أ.دائما	ب. أحيانا	ج. أبدا
6. خلال الرش هل تقوم بأي من الآتي؟	أ. التدخين	ب. الأكل والشرب	ج. مراعاة الرياح
7.هل ترش المبيد والسماد في نفس الوقت؟	أ.دائما	ب.أحيانا	د.أبدا
8. بعد عملية الرش هل تراعي أن تنظف جسمك وأدوات يعيدا عن مصادر المياه	أ.دائما	ب. أحيانا	ج.أبدا
9.أنظف علب المبيد والسماد وأدوات الرش بمياه الآبار أو البرك وغيرها من مصادر المياه .	أ.دائما	ب.أحيانا	ج.أبدا

10.التعامل مع المتبقي من محلول الرش.

أ.يكرر الرش على المحاصيل مرة ثانية لحين الانتهاء منه.
ب.يسكب على الأرض داخل المزرعة
ج.يسكب في المجاري.
د.التخلص بأداة عن طريق الدفن .
ه.حساب الحجم اللازم بدقة والرش بدون فائض.
و.لا توجد إجابة ولا طريقة للتعامل.
ز.غير ذلك اذكر --------------------

11.أي التالية ينطبق عليك.

أ. أروي النبات قبل رش المبيد أو السماد
ب. أخلط المبيد أو السماد في مياه الري
ج.أروي النبات مباشرة بعض الرش
د. أروي النيات بعد فترة من الرش

12.ماذا تفعل بعلب المبيدات أو الأسمدة الفارغة؟

أ.أعيد استخدامها للأغراض المنزلية ب. تخزين مبيد آخر
ج. رميها في مكب النفايات د. حرقها
هـ.غير ذلك................

13. بعد عملية الرش أقوم بما يلي؟ (اختر كل ما ينطبق)

أ. تبديل ملابسك التي تعرضت للرش مباشرة
ب. غسل الملابس التي تعرضت للرش مع ملابس الأسرة
ج. غسل اليدين قبل مغادرة الحقل
د. الاستحمام مباشرة
هـ. غير ذلك ....

14. بعد رش المحصول أقوم بما يلي؟

أ. لا أقطف المحصول إلا بعد مرور فترة الأمان (الفترة ما بين اخر رش وفترة الحصاد
ب. أقطف على الأقل بعد يومين
ج. اقطف بعد جفاف المبيد
د. أقطف المحصول في أي وقت

ثالثا: مدى معرفة المزارعين بأثر المبيدات على الوضع الصحي و البيئة :

1. هل تعاني من أي من الأعراض الصحية التالية بشكل متكرر؟

صداع - آلام صدر – التهاب جلد – ضيق تنفس – قحة - تعرق - ضعف عام- التهاب الجلد - حكة- غثيان – دوخة - إسهال – ارتفاع درجة الحرارة - نسيان – رجة أرجل أو أيدي

غير ذلك ....

2. إذا كنت تعاني احد من هذه الأعراض يمكن أن ترجع السبب إلى استخدام المبيدات.
أ. دائما ب.أحيانا ج. أبدا

3. أي من التالية ينطبق عليك:
أ. أحاول استخدام أساليب أخرى غير المبيدات قبل أن ألجأ للمبيدات
ب. أستخدم المبيدات كلما لزمت كحل أول للآفات
ج. أعمل دائما حسب إرشاد المشرف الزراعي في منطقتي
د. أعمل دائما حسب إرشاد المسؤول في مركز بيع المواد الزراعية

4. كيف تحصل على مزيد من المعلومات عن المبيدات والأسمدة وكيفية التعامل معهما ؟
أ. الناس والمزارعين
ب. الإعلام
ج. الموردين شركات المبيدات
د.البرامج الإرشادية من قبل وزارة الزراعة
ه. غير ذلك ،اذكر -----------------

5. هل حاولت استخدام إحدى الطرق التالية كبديل
6. للمبيدات ؟
أ. الزراعة العضوية ب. الطرق الميكانيكية والفيزيائية
ج. المكافحة الحيوية باستخدام الأعداء الطبيعية
د.لا اعرف عن أي من هذه الطرق
و. الأصناف النباتية المقاومة للآفات
ه.لا يوجد بديل عن المبيدات
ز.غير ذلك ، اذكر ------------

7. هل تناقش مع المزارعين في منطقتك حول المبيدات والأسمدة وأساليب استخدامهما وتأثيرها على البيئة؟ أ. دائما ب.أحيانا ج. أبدا

8. هل تعتقد أن المبيدات والأسمدة ممكن أن تلوث مصادر المياه أ. دائما ب.أحيانا ج. أبدا

9. هل تعتقد أن المبيدات والأسمدة ممكن أن تصل إلى المياه الجوفية ؟ أ. دائما ب.أحيانا ج. أبدا

10. هل تعتقد أن المبيدات والأسمدة ممكن أن تتراكم في التربة وتغير من صفاتها ؟ أ. دائما ب.أحيانا ج. أبدا

11. هل تعتقد أن المحصول الذي رش علية المبيد امن للاستهلاك البشري؟ أ. دائما ب.أحيانا ج. أبدا

12. هل تعتقد أن رش المبيد يمكن أن يعرض الحيوانات كالطيور إلى الخطر؟ أ. دائما ب.أحيانا ج. أبدا

13. أثناء رش المبيد ها تعتقد أن المبيد يمكن أن يلوث الهواء وبالتاي ينتج عن ذلك مشاكل صحية أ. دائما ب.أحيانا ج. أبدا

14. هل أخبرت إحدى الجهات المختصة في الزراعة أو الموردين عن مشكلة واجهنك في نوعية المبيد والسماد أو أثناء استخدامه؟ أ. نعم ب.لا

رابعا: تقييم ممارسات المزارعين أثناء ري المحاصيل

1.نوع الري الذي تستخدمه عادة في مزرعتك | أ.بالرشاشات | ب.بالتنقيط | ج.بالقنوات السطحية | د.الري السطحي | ه.غير ذلك،اذكر-----------

2.مصادر مياه الري | أ. خزانات جمع مياه المطر المغطاة | ب.آبار المياه الجوفية في المزرعة | ج.مياه المجاري | د.شراء المياه | ه.البرك السطحية | و. غير ذلك اذكر -----------

3.إذا يوجد في مزرعتك آبار للمياه الجوفية كم عددها؟ ----------------------------

4.عدد مرات الري في الصيف؟ | أ.0-6 مرات | ب.7-11مرة | ج.أكثر من12مرة

5.مياه الري في الصيف. | أ.كافية | ب.بعض الأحيان كافية | د.غير كافية أبدا

6.المشاكل التي تواجه مياه الري في الصيف. | أ.لا توجد مشكلة | ب.تخزين المياه | ج.تلوث المياه | د.تكلفة المياه | ه.ملوحة المياه | و.غير ذلك،اذكر----------

7.عدد مرات الري في الشتاء. | أ.0-4مرات | ب.5-7مرات | ج.أكثر من8مرات

8.مياه الري في الشتاء. | أ.كافية | ب.بعض الأحيان كافية | د.غير كافية أبدا

9.المشاكل التي تواجه مياه الري في الصيف. | أ.لا توجد مشكلة | ب.تخزين المياه | ج.تلوث المياه | د.تكلفة المياه | ه.ملوحة المياه | و.غبر ذلك،اذكر-----

10.أ.هل استخدمت مياه الصرف الصحي والمجاري في الري ؟ | أ.نعم | ب.لا

ب.إذا كانت إجابتك نعم ،دوافعك لاستخدام مياه الصرف للري. | أ.عدم توفر مياه الري | ب.تكلفة المياه | ج.اعتقد أن التربة تقوم بتنقية مياه المجاري لذلك تصبح غير ضارة | د. لأن النبات ليس لاستخدام البشري | ه.غير ذلك ،اذكر-------------

11.مصدر معلوماتك التي تحتاجها لتحدد كمية المياه التي للازمة لري.
أ. مهندس زراعي
ب.موظفي وزارة الزراعة
ج.الجمعيات الزراعية الخاصة
د. التلفاز والراديو
ه. الأقارب والأصدقاء
و .الخبرة العملية الشخصية
و.المزارعين
ح.غير ذلك،اذكر-------

12.المشاكل التي تواجهها المياه بشكل عام في حوض الفارعة.
أ.عدم توفر المياه على مدار العام
ب.صعوبة وصول المياه إلى المزرعة
ج.الاحتلال
د..تلوث المياه
ه.عدم تساوي الحصص بين المزارعين
و. غير ذلك ،اذكر-----

13.أ.هل تعتقد أن المياه المستخدمة في الري ملوثة ؟
أ.نعم
ب. لا

ب.إذا كانت إجابتك نعم ،إلى ماذا ترجع السبب ؟
أ.مياه المجاري
ب.بقايا المبيدات والمخصبات
ج.الحيوانات الميتة وفضلاتها
د.ترسبات من التربة
ه.مخلفات المنزل أو المصانع
و. غير ذلك،اذكر------

14.شبكة الري تم تركيبها بناءا على
أ.معرفة سابقة
ب. مهندس أو خبير في الري
ج.بمساعدة المزارعين في المنطقة
د.غير ذلك اذكر -

15.يتم صيانة الشبكات وتنظيفها بشكل دوري
أ.دائما
ب.أحيانا
ج.أبدا

16.هل سبق وان شبكات الري أغلقت بسب النفايات
أ.دائما
ب.أحيانا
ج.أبدا

17.مصدر تلوث شبكات الري
أ.بقايا المبيدات والأسمدة
ب.حيوانات ميتة
ج. مياه الصرف الصحي
د.بقايا التراب
ه.النفايات المنزلية
و.غير ذلك اذكر

جامعة النجاح الوطنية
كلية الدراسات العليا

تقييم الآثار الناتجة عن الممارسات الزراعية غير المضبوطة على مصادر المياه والتربة في حوض الفارعة

إعداد
دعاء فايز عبدالله

إشراف
أ.د مروان حداد

قدمت هذه الأطروحة استكمالا لمتطلبات الحصول على درجة الماجستير في العلوم البيئية بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس- فلسطين.

2014

تقييم الآثار الناتجة عن الممارسات الزراعية غير المضبوطة على مصادر المياه والتربة في حوض الفارعة

إعداد
دعاء فايز عبدالله
إشراف
أ.د. مروان حداد

الملخص

إن الاستخدام المفرط للأراضي الزراعية والمياه في حوض الفارعة وبدون إدارة سليمة يحمل العديد من المخاطر على البيئة، حيث أن الممارسات الزراعية المختلفة تحدث تلوثا من خلال تراكم العديد من المواد الملوثة كالمبيدات والأسمدة والمعادن الثقيلة في المياه والتربة وبالتالي انتقالها و تراكمها في المحاصيل الزراعية.

لتقييم أثر الممارسات الزراعية المختلفة على مياه الآبار والتربة و المحاصيل الزراعية في حوض الفارعة، تم أخذ عينات مياه من 33 بئر زراعي من مناطق مختلفة من حوض الفارعة لتحليل مستوى النترات والفوسفات والأكسجين الممتص حيويا والأكسجين الممتص كيميائيا وعسر الماء والمواد الذائبة كليا والموصولية الكهربائية ودرجة الحموضة، وتم جمع عينات من التربة على ثلاثة أعماق مختلفة (0- 20 و 20-50 و 50-100 سم) ومحاصيل زراعية من حقول زراعية مختلفة من حوض الفارعة لتحليل تراكم النترات والفوسفات وبعض المعادن الثقيلة (الرصاص و الحديد والزنك و الكادميوم والنحاس والنيكل) وبقايا مبيد اللفرون والامابكتين.

كما تم في هذا البحث تعبئة استبيان من قبل 155 مزارع حيث كان الهدف منه دراسة وتقيم درجة الوعي وطريقة التعامل مع المبيدات والأسمدة قبل وأثناء وبعد عملية الرش من قبل المزارعين وتقيم الممارسات المختلفة خلال الري في حوض الفارعة.

أظهرت النتائج أن واحدا من أصل 33 بئرا يحتوي على تركيز من النترات أعلى من الحد المسموح به من قبل منظمة الصحة العالمية لمياه الشرب ولكن ضمن الحد المسموح به في مياه الري، وكذلك بالنسبة لمستوى الفوسفات حيت بئر واحد يحتوي على مستوى أعلى من الحد المسموح به لمياه الشرب وكذلك لمياه الري، أما بالنسبة لمستوى والمواد الذائبة كليا و الموصولية الكهربائية و قيم درجة الحموضة كانت ضمن الحدود المسموح به لمياه الشرب من قبل منظمة

الصحة العالمية وكذلك ضمن الحد المسموح به لمياه الري من قبل منظمة الأغذية والزراعة .ووجد أن مياه الآبار تعاني من عسرة عالية. وأظهرت النتائج أن مستوى الأكسجين الممتص حيويا في ثمانية آبار ومستوى الأكسجين الممتص كيميائيا في بئرين كان أعلى من الحد المسموح به لمياه الري.

أظهرت النتائج أن مستوى الفوسفات في التربة أعلى من التركيز المسموح به وأكثر من كمية الفوسفات تحتاجها المحاصيل الزراعية وأعلى تركيز للفوسفات وجد على عمق 0-20 سم. أظهرت النتائج أن هنالك تراكم للنترات في التربة وأعلى تركيز كان على عمق 20-50 سم. بينما كانت مستويات المعادن الثقيلة في التربة أقل من الحد الأقصى المسموح به من قبل منظمة الصحة العالمية. لكن مع مرور الوقت يمكن أن يزاد تراكمها فتشكل خطرا على التربة والنبات. وكان ترتيب تراكيز المعادن في التربة كالتالي الحديد > الزنك > النيكل > النحاس > الرصاص > الكادميوم في التربة. وتبين أن هنالك بقايا لكلا المبيدين(اللفرون والامابكتين) في التربة .

أما بالنسبة للمحاصيل الزراعية كان محتوى النتروجين اقل من التركيز الأقصى المسموح به من قبل منظمة الصحة العالمية، وجد أن تركيز النترات والفوسفات كان أعلى ما يمكن في أوراق كلا المحصولين، وبالإضافة إلى ذلك نبات الخيار كان له القدرة على تراكم الفوسفات والنترات في أجزاءه أكثر من نبات الباذنجان .أما بالنسبة لتراكم المعادن الثقيلة في المحاصيل الزراعية فكان يتأثر بنوع المحصول وطبيعة المعدن، وكان نبات الخيار بجميع أجزاءه أكثر تراكما للمعادن الثقيلة.وجاء ترتيب تراكيز المعادن المفحوصة في كلا المحصولين كالتالي الحديد > الزنك > النيكل > النحاس > الرصاص > الكادميوم، وأظهرت النتائج أن تركيز النيكل والنحاس في كلا المحصولين لم يتجاوز الحد المسموح به من قبل منظمة الصحة العالمية، بينما كان تركيز الكادميوم والرصاص في جميع أجزاء المحصولين و تركيز الحديد في أوراق وساق كلا المحصولين وتركيز الزنك في ساق نبات الباذنجان أعلى من الحد المسموح به. كانت نتائج تحليل بقايا مبيد اللفرون في الفوصولياء والأمابكتين في الباذنجان أعلى من الحد المسموح به عالميا.

كشفت نتائج الاستبيان أن درجة مستوى المعرفة والوعي وطريقة التعامل مع المواد الكيميائية الزراعية عند المزارعين كانت متوسطة. وكان معظم المزارعين حاصلين على تعليم إعدادي

وثانوي وحتى جامعي وبالتالي هذا يمكنهم من استيعاب التكنولوجيا الجديدة في مجال حماية النبات. وكشفت النتائج أن معظم المزارعين في حوض الفارعة لم يتلقى التدريب الفعال للتعامل مع المبيدات وأن معظمهم لا يعرفون التقنيات والبدائل الحديثة للمواد الكيمائية الزراعية وأن استعمال المبيدات الحشرية هو الحل الأفضل بالنسبة لهم. ووجد أن المزارعين يأخذون الإحتياطات اللازمة لمنع تلوث مياه الآبار .