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RAISING FARMERS ENVIRONMENTAL AWARENESS IN THE USE OF PESTICIDES AND AGRICULTURE MACHINERY

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We certify that thesis is fully adequate in scope and quality for the degree of Master of Arts in Environmental Education and Management.

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ABSTRACT

RAISING FARMERS ENVIRONMENTAL AWARENESS IN THE USE OF PESTICIDES AND AGRICULTURE MACHINERY

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The study was mainly to determine the farmers awareness in the use of pesticides and agricultural machinery used to spray pesticides in East Tripoli, Libya. Quantitative methods were used with questionnaires administered to 300 respondents as farmers and the result was statistically analyzed using Statistical Package for Social Science SPSS. From 8 research questions considered, the results showed that in East Tripoli the farmers earn 50% of their income by selling their farm products in the market which are mainly vegetables. Most of the farmers own a store to keep and protect their chemicals under lock in the chemical original packs. For the farmers to know the hazards associated with the chemicals or pesticides to be used they read the instructions before use and they wear protective clothes while preparing the solution. The type of protective clothes the farmers in East Tripoli majorly wear are gloves and this type of PPE has been used for the past 11 years and above. There is a statistically significant and linear combination of independent factors significantly related to PPE’s that protect the farmers from denger and farmers’ knowledge about safe use of PPE’s. There is a statistically significant difference between male and female farmers influence on the awareness of spraying plant and vegetal plants. Therefore, gender influences the awareness of spraying plants and vegetal products. There is no correlation or relationship between farmers education level and purchasing of agricultural products. Therefore, farmers education level affects purchasing agricultural products. There is also no correlation or relationship between application of PPE and type of sprayer.

The result suggested that monthly income does not have any significant positive difference in the use of machineries associated with pesticide application.

The farmers are aware of modern machinery for spraying of pesticides and they also use irrigation system during the process of spraying which indicates that they make use.

Keywords*:* pesticides, farmers, machinery, personal protective equipment, misapplication, spraying.

ÖZET

TARIMDA PESTİSİT VE MAKİNELERİN KULLANIMINDA ÇİFTÇİLERİN ÇEVRESEL FARKINDALIKLARININ ARAŞTIRILMASI

Ismail ALBAKOUSH

Yüksek Lisans, Çevre Eğitimi ve Yönetimi Anabililm Dalı

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Bu çalışmanın asıl amacı Libya'nın Doğu Timor kentinde kullanılan tarımsal ilaçların çevresel etkilerine yönelik olarak çiftçilerin farkındalığını saptamaktır. Çalışmanın nicel verilerini oluşturmak amacıyla 300 katılımcıya yöneltilen anket sorularında Sosyal Bilimlerde Statistiki Veri Paketi (SPSS) kullanılmıştır. Kullanılan sekiz anket sorusu göz önüne alındığında, Doğu Tripoli'de yaşayan çiftçilerin gelirlerinin yarısını, büyük çoğunluğunu kendi yetiştirdikleri ve özellikle de fazlasının sebzelerden oluşan ürünlerini, halk pazarlarında satarak elde ettikleri gelirler oluşturmaktadır. Çiftçilerin tamamına yakınının ürünlerini yetiştirmek amacıyla kullandıkları kimyasal içerikli tarımsal ilaçlarını saklayıp muhafaza ettikleri depoları vardır. Kimyasal içerikli tarımsal ilaçların hazırlanışı esnasında kullanım talimatlarını okuyor ve bunların kullanımı esnasında zararlı etkilerinden korunmak amacıyle de özel kıyafetler giyerler. Doğu Tripoli'deki çiftçilerin büyük çoğunluğunun tarım ilaçlarına karşı tedbiren kulllandıkları giysileri 11 yıl ve daha öncesine dayanan geleneksel kıyafetler ve özellikle de tercih ettikleri eldivendir. Çiftçilerin tarımsal ilaç kullanımı ile tarımsal ilaçların zararlı etkilerinden korunma yöntemleri hakkındaki bilgilerinin PPE ölçeğine göre doğrusal bir paralellik gösterdiğini ispatlayan istatistiki veriler mevcuttur. Yapılan bu çalışma ile kadın ve erkek çiftçiler arasında tarımsal ilaç kullanımı ile yapılan bitkisel üretim çeşitlerinde tarımsal ilaçların zararlarına yönelik farkındalık hususunda önemli ölçüde farklılıkların olduğunu gösteren istatistiki veriler de ortaya konmuştur. Dolayısıyle, püskürtme yöntemi kullanılarak yapılan tarımsal üretim faaliyetleri bağlamında tarımsal ilaçlara yönelik farkındalık kıyaslanmasında cinsiyet ayrımı oldukça dikkat çekici bir boyuttadır. Buna ilaveten,

tarımsal ilaç satın alımı ve kullanımı ile eğitim seviyesi arasında herhangi bir korelasyon veya doğru orantılı bir ilişki bulunmamaktadır. Ayrıca, yapılan istatistiki çalışmalara göre kişisel koruyucu araç-gereçler (PPE) ile püskürtme yöntemleri arasında da herhangi bir korelasyon ya da doğru orantılı bir ilişki bulunmamaktadır.

Sonuç olarak, yapılan çalışmalara göre aylık gelirin tarımsal amaçlı makine kullanımına olumlu bir etki ettiği de gözlemlenmemiştir.

Çiftçiler modern tekniklerle tarımsal ilaç püskürtme yapabilen makinelerin varlığından haberdar olmakla birlikte, modern yöntemlerle sulama yapabilmekte ve tarımsal ilaçlara karşı duyarlılıkları da her geçen gün artmaktadır.

Anahtar kelimeler: tarımsal ilaçlar, kişisel koruyucu araç-gereç, püskürtme, çiftçiler, makineler, yanlış kullanım.

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I am grateful to my wonderful mates friends and well-wishers.

Ismail ALBAKOUSH

June, 2018,

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ABBREVIATIONS

AAPCP	Association of American Pesticide Control Officials
DDT	Dichlorodiphenyltrichloroethane
EPA	Environmental Protection Agency
FAO	Analysis of Variance
FIRA	Fungicide and Rodenticide Act
GDP	Gross Domestic Product
OCPS	Organochloride pesticide
OP	Organophosphate
PPDC	Program for Pesticide Dialogue Committee
PPE’s	Personal Protective Equipment
SDTF	Spray Drift Task Force
SPSS	Statistical Package for Social Science
UK	United Kingdom
UNEP	United Nation Environmental Protection
USDA	United State Department of Agriculture
WHO	World Health Organization
%	Percentage

CHAPTER I
INTRODUCTION

Agriculture practices address a basic constituent of Libyan economy where it uses around 5 % of the work problems and gives around 9 % of the Gross Domestic Product (GDP). Animal husbandry is so far a colossal development, depends vivaciously on imported feed. The unsustainable use of these benefits assets to an extraordinary long-term natural and money related hazard to Libya's cultivating lands. As the world moves towards the next century, direction and getting ready for the best usage of pesticides to control pest, diseases and weed issues in cultivation, will expect a reliably expanding significance (The World Bank, 2017).

To nourish a total populace, forecast to grow from 5300 million out of 1990 to 10200 million by 2075, from existing area region zones, using reasonable production frameworks, with irrelevant hostile results for people and the environment, is an overwhelming undertaking. The issue is around the world. Finding its answer presents government authorities, financially related organizations, agriculturists and the agrochemical business a gigantic test. Propel increment of world horticulture, particularly in Asia, Africa, Latin America and the Caribbean, is an unavoidable objective. Extension of the total populace is centered on these zones (UNCTAD, 2013).

1.1 Problem Statement

How to raise the efficiency of farmers to improve environmental awareness in the use of pesticides and agricultural machinery used to spray pesticides in Tripoli Libya.

1.1.1 Sub-Problem

1. Does farmers’ knowledge about safe use of personal protective equipment PPEs protect them from health effect?

2. Does gender influence the awareness of spraying plant and vegetal products?

3. Are the farmers sensitive to the misapplication of protective products?
4. Does the farmers' education level affect purchasing agricultural chemicals?
5. Does PPEs use related with the type of sprayer use?
6. Does monthly income make any difference in the use of machineries associated with pesticide application?
7. Are farmers aware of the machineries associated with pesticide application?
8. Do farmers use agricultural machinery during control operations?

1.2 Aim of the Study

1. To determine environmental awareness of farmers towards pesticides.
2. To evaluate farmers' knowledge on personal protective equipment.
3. To evaluate how awareness influences the quality machineries of spraying plant and vegetal products.
4. To determine how farmers are sensitive to the misapplication of protective product.
5. To determine farmers awareness of the machineries associated with pesticide application.
6. Evaluation of farmers' knowledge of spraying machines.

1.3 The Importance of the Study

Since the 1940s, agrochemicals have been heavily used in agriculture around the world to control diseases that affect a variety of pests and plants. Pesticide is a mixture of substances used to prevent, reduce any harmful substances or fungi (fungi, moss or bacteria) (2014 FAO insects (insecticides), rodents (rodenticides) and weeds (herbicides) EPA, 2016). Damages and diseases can reach 78%, 54% and 32%, respectively, because the pesticides from the pests are the incentives to use pesticides in agricultural production without the application of fruit and vegetables and cereals (Pimentel 2005 Cai, 2008). Thus, the use of pesticides is increasingly recognized as an indispensable practice for adequate food production in arable land boundaries for the world population (FAO 2009, 2015). Other advantages of the use of pesticides, sorting and other tasks are needed to free the storage of product life and less labor to improve (Cooper and Dobson, 2007).

The use and number of different pesticides vary by region. For example, the rate of pesticide consumption has increased by 48% in 2005 and by 20% in 1960 (Zhang et al., 2011, FAO, 2015). Moreover, with herbicides in Western Europe and North America, chemical weed control is more prevalent than East Asia, Latin America or Africa because of high labor costs. However, insects are also used in large quantities in both small farms and industrial plantations, and insect pests and plant diseases are common in many tropical regions. Countries have developed the use of natural enemies of pests, as well as less chemicals and less toxic substances, as is the case for the current use of pesticides, for example in the US and EU countries.

1.4 Assumptions

1. The farmers awareness in the East Tripoli shows their knowledge about pesticides spray machineries and pesticides environmental impact
2. It is approved that the farmers that participated in the research are qualified.
3. Answers given by farmers for the questionnaires are sincere.
4. The inadequate knowledge of farmers on this subject will affect their actions towards the environment negatively.
5. Related literature obtained for this study is assumed to be sufficient.

1.5 Limitations

The limitations of the study are stated below:

- The study was limited to 300 farmers residing in East Tripoli, Libya.
- This research was limited to only farmers around East Tripoli
- There was a language barrier in the study
- The resources were restricted

1.6 Definitions

Awareness is defined as the ability to make forced-choice decisions above a chance level of performance. The second definition, proposed by Henley (1984), is subjective and simply equates awareness with self-reports indicating that an observer "consciously sees" a stimulus.

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest (FIFRA, 1946).

CHAPTER II
LITERATURE REVIEW

2.1 Fate Processes of Pesticides in the Environment

Pesticide brought into the environment by application, a transfer or a spill is affected by many processes (Tiryaki and Temur, 2010). These processes decide a pesticide's ability to persist in the environment, movement, assuming any and its definitive fate. The movement process can have both positive and negative effects on pesticide's viability and its effect on nature. They can move a pesticide to the objective zone or destroy its potentially harmful residues. Once in a while, they can be adverse, prompting reduced control of objective residues, damage of non-target plants and animals and ecological damage (Duttweiler and Malakhov, 1977; Arnold and Briggs, 1990; Waite et al., 2002). Of specific concern today is the movement of pesticides into groundwater and its high concentration in the food chain. However, distinctive soil attributes (pH, clay, sand, organic matter and so forth.), pesticides qualities (water solubility, tendency to adsorb to the soil, persistence, its resistance to being broken-down over time, and so on.), climatic components, application strategies and diverse handling practices of pesticides for example can advance or prevent each process (Braschi et al., 2011).

A comprehension of the fate forms guarantees that applications are not only effective but as well environmentally safe. Fate processes of pesticides in the environment could be gathered into four major types: (I) absorption, where pesticides are bound with soil; (II) debasement/degradation, i.e. pesticides separate or are broken down, (III) transfer forms, i.e. pesticides are moved far from an application range, and (IV) Absorption, i.e. pesticides taken up by plants and animals. These physical and chemical properties of pesticides decide their environmental hazard.

2.1.1 Absorption

Pesticides and other organic molecules in the soil can be absorbed by soil particles. Pesticides absorption is the binding or fascination of pesticides to soil particles like iron filings or paper cuts adhering to a magnet (Sangchan, 2012). The level of absorption between the soil and pesticides impacts the bioactivity, leachability, and degradability of these chemicals in a given environment, and influences their conveyance through the soil profile. The measure of absorption in the soil relies upon the kind of soil and its holding potential, the soil qualities (temperature, pH, moisture content, moisture content, organic matter content, particle size, and so forth.), the attributes of the pesticides (molecular structure, electrical charge, solubility, etc.) and its amount in the soil water (Dao and Lavy, 1978; Wauchope and Myers, 1985).

2.1.2 Degradation

Pesticide degradation is the breakdown of pesticides in the environment. Pesticides half-life measures the rate at which degradation happens. A pesticide with a long half-life is depicted as steady or persistence. Majorly, the more extended the half-life is the more prominent the potential for pesticide movement is (Tiryaki and Temur, 2010). Pesticide degradation is generally useful as pesticide-destroying reactions change most pesticide buildups in the environment to non-dangerous or innocuous mixes (Fishel, 2003). However, degradation is unfavorable when a pesticide is crushed before the objective vermin has been controlled. Microbial/organic, chemical and photochemical degradation are the three general types of pesticide degradation.

Microbial degradation is the breakdown of pesticides by growths, microscopic organisms and other miniaturized scale life forms that utilize pesticides as a sustenance source (Sangchan, 2012). It is the most well-known sort of pesticide breakdown. This is an imperative process by which soil microorganisms or aquatic organisms can detoxify chemicals (Solaimalai et al., 2004). However, the development of a more lethal chemical may come about because of the microbial degradation process. Chemicals that are profoundly water dissolvable can biodegrade, yet those with low water solubility mostly do not. Most microbial degradation of pesticides happens in the soil. The rate of microbial degradation in soil is influenced by moisture, temperature, aeration, pH and the amount of organic matter. This is a result of their immediate effect on microbial degradation and activity (Sangchan, 2012). A factor that can impact microbial degradation is the recurrence of pesticide application. Fast microbial degradation is more probable when a similar pesticide is utilized over and again in a field as repeated applications can fasten the degradation of life forms that are viable in degrading the compound (Solaimalai et al., 2004).

Among these, hydrolysis, a breakdown process in which the pesticide reacts with water, is stressed as the major process. Hydrolysis is sensitive to temperature and is pH-dependent. Numerous organophosphate and manufactured pyrethroids pesticides are especially susceptible to hydrolysis under basic conditions. Some are really separated or broken down in a short time when mixed with alkaline water. The rate of hydrolysis might be slower under acidic to neutral conditions (Fishel, 2003). Photochemical degradation is the breakdown of pesticides by ultraviolet or visible light, particularly sunlight (Sangchan, 2012).

Pesticides on foliage, on soil, in water and even noticeable all around can be destroyed by this process. Components that impact this sort of degradation incorporate intensity of the sunlight, length of exposure, attributes of the application site, for example, soil type, depth of the chemical in soil and water, sensitizers, vegetation cover, application strategy, and the physical and chemical properties of the formulated pesticide (Fishel, 2003; Solaimalai et al., 2004).

2.1.3 Transfer/Transport

Chemical degradation is the breakdown of pesticides by forms that don't include living beings. Chemical forms including hydrolysis, oxidation-reduction and ionization are in charge of degradation and change of pesticides in soils and water, through the presence of excess acidity or alkalinity, and this is identified with pH (Sangchan, 2012). As soil pH turns out to be extremely acidic or basic, microbial activity generally diminishes, yet such conditions may bring about an increase in chemical degradation (Fishel, 2003).

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Run-off is the mobility of water over the land surface or a slanting surface as instead of through the soil. Run-off happens when water application is applied quicker than it can invade the soil (Osunbitan et al., 2014). The amount and severity of pesticides in runoff water is a component of site-related factors, for example, the slope of the land and moisture content of the soil. Climatic factors, for example, temperature, the amount and timing of precipitation in respect to the pesticide application are additionally of impact (Osunbitan et al., 2014).

Different variables to note are the pesticide-water-soil interactions, for example, the solubility and absorptivity of the pesticide, the erodibility and the surface of the soil. Generally, pesticide losses in runoff are most likely to occur when a heavy or sustained rainfall follows soon after a pesticide is applied (Fishel, 2003). Steep slopes, wet soils, and poor vegetative cover all add to abnormal amounts of run-off.

Certain physical and chemical properties of the pesticide, for example, how rapidly it is absorbed by plants or how firmly it will bound to plant tissue or soil, are additionally imperative. A few pesticides are so firmly adsorbed that they will stay attached to particles of soil and organic matter even when these solids are suspended in run-off water (Sangchan, 2012).

Leaching is the downward movement of pesticides in water through the soil instead of over the surface. Pesticide leaching depends in parts on the pesticide's chemical and physical properties (solubility, absorption, volatility, degradation, separation, evaporation and precipitation) (Kordel and Kleim, 1992). For instance, a pesticide held strongly/firmly to soil particles by absorption is less likely to be leached (Osunbitan et al., 2014). Solubility is another factor that influences the leaching of pesticides. A pesticide that breaks up promptly in water is said to be highly soluble and can move with water in the soil. Moreover, the perseverance, or lifespan, of a pesticide likewise impacts the probability of leaching (Kordel and Kleim, 1992). As indicated by Laprade (2002) and Osunbitan et al. (2014), a pesticide that is quickly separated by a degradation process is less likely to leach since it might stay in the soil just for a brief time. In any case, the longer the compound lasts before break down, the more it is liable to the forces of leaching. In the event that a pesticide is exceptionally unpredictable and not highly water soluble, it is probably going to be lost in the environment, and less will be accessible for leaching. Soil factors that impact leaching incorporate soil type, soil moisture content and availability, soil pH, texture, organic matter present and microbial group (Fishel, 2003). These variables impact leaching due to their impact on pesticide absorption (Arnold and Briggs, 1990). Soil porousness (how readiy water travels through the soil) is likewise critical. The more porous a soil is the more prominent is its potential for pesticide to leach down the soil profile (Laprade, 2002).

A sandy soil, for instance, is substantially more porous than clay earth soil. Ordinarily, the nearer the time of application to a heavy or sustained rainfall is the more prominent the probability that leaching of a few pesticides will happen (Laprade, 2002). Pesticides leaching down the soil profile is of extraordinary concern both in connection to the potential for a chemical to travel through the soil and pollute groundwater and pesticide productivity. A moderate transport through soil and subsoil materials may bring about an increased substance of pesticides in the groundwater. A specific measure of pesticide leaching might be basic for control of pest. An excess leaching, in any case, can prompt decrease in pest control, damage of non-target species and groundwater pollution (Osunbitan et al., 2014).

2.1.4 Absorption

Absorption or take-up of pesticides is the movement of pesticides into plants and animals and the capacity of the compound or its degradation product inside the tissues of that living organism (Tangahu et al., 2011). Absorption of pesticides by target and non-target life forms is impacted by environmental conditions and by the physical and chemical properties of the pesticide and the soil. Once taken up or absorbed by plants, pesticides might be separated or they may stay in the plant until the point that tissue roots or get harvested. Pesticide build-up or accumulation can cause long-term harm or death (Fishel, 2003). It can likewise develop in the food chain: a process called bio-magnification. Bio-magnification brings about significantly more persistent pesticides exposures in living organisms at the highest in a food chain. Bio-magnification of persistent pesticides in the food chain was one reason for banning of organ chlorine pesticides, for example, DDT (Solaimalai et al., 2004). Bioaccumulation and bio-magnification likewise happen in the aquatic system. Fishes, for instance, are influenced when their water territories or food sources are polluted. The degree of harm to the fish depends on the properties of the pesticide as well as on the types of fish, its age, size and its position in the food chain (Fishel, 2003). According to global pesticide production in 2015 there was an increase to 2.5 x10^6 tonnes (Figure 1).

Figure 1.
Total global agro pesticide (active ingredients) production 1940-2015.

Source: http://faostat3.fao.org/download/R/RP/E (FAOSTAT, 2016).

2.2. The role of Pesticide and its Significant Effects

The farmers in Libya, use may often lead to undesirable consequences for the environment and human health, despite the pesticide-positive role of protecting pests and less disease at the economic level (Owombo et al., 2014). In most of the developing countries, the abuse and pesticide use due to these effects (Fianko et al., 2011), as well as lack of ignorance or security problems, were usually severe. Pesticides and toxicity due to environmental pollution and threats to human health, soil, water, animals and plants have been shown to be of great concern to many researchers. Soil drug pollution is an important environmental problem because soil micro flora and micro fauna have a significant effect on the ecosystem (Bentum et al., 2006).

These chemicals can also penetrate surface waters and underground waters at the same time. The presence of pesticide in the soil increases the risk of the bioaccumulation end-point ecosystem and, after consumption; it has been shown that food may be transferred to another, causing acute or chronic toxicity in humans (Ortiz-Hernandez et al., 2011). In recent years, many acute and chronic human diseases are associated with low dose exposure to pesticides (Mostafalou and Abdollahi, 2012). Bempah and Donkor, 2011; Bempah et al., 2011). In addition, studies have shown that significant amounts of available pesticides are found in soil, sediments, water, plants, meat, fish and human body fluids (Darko and Acquaah 2007, Tutu et al., 2011. Kuranchie-Mensah et al., 2012.).

Pesticide and natural / environmental quality and adverse effects on human health have been around the world, and eventually become a serious problem for national, regional and global scales (Hough, 2003; WAIBEL 2007; Ntow, 2008). WHO (2009) classifies five groups of pesticides at their own level in response to extremely dangerous (category 1a) hazardous high-risk (Class Ib) medium hazardous (Class II) dangerous class. For this reason, changing the global distribution pattern of pesticide production and its use has great influence on human welfare and the environment. This is especially true in developing countries where application of horticulture in practice is regularly inadequate. About 500 pesticides are currently being used. The highest environmental pollutants among these pesticides are organ chlorine pesticides (Zhang et al., 2011).

The various common forms of pesticides are: liquid, wet table powders, emulsifiable concentrates, and dust, and spraying time, pesticides in the environment of these forms of pollutants. A poison that has entered the human body can only reach the target with a share of 1%, and 99% human health or environmental pollutants such as water, soil, air and non-target organisms, and this volatilization, leaching and landing direct threat should be considered (Damalas and Eleftherohorinos, 2011).

Organ chlorine insect killers remain at an alarm level today even though they have been around 10-25 years ago. Surface and endosulfan sulfate, metabolite endosulfan juices, very common pollutants are used in many countries (Ondarza et al., 2010, 2011. Gonzalez et al., 2010).

We can also assume that pesticides are added to the loss of biodiversity and the collapse of a normal life habitat (Ntow, 2008). Van Den Brink et al., (2013)). In this study, we investigated the effect of food and water on the digestion of food. (For example, apple, strawberry, nectarine, peach, celery, grape, cherry, spinach, nectarine, etc.), for five consecutive years as the most polluted culture.

Pesticides can be harmful to human health and exceed the level of exposure to humans (Skevas et al., 2003., Garming & Amp, 2013., Waibel, 2009). Although developing countries use only 25% of the world's pesticides, they face 99% of the transitions (Jansen, 2008, Hoi et al., 2013, Handford et al., 2015).

In this study, various investigations are characterized by serious occupational health problems associated with the use of pesticides (Hurley et al., 2000; Tawatsin, 2015). For example, according to the WHO report and UNEP, there are more than 26 million human pesticide poisonings worldwide with approximately 340,000 deaths per year (Asita and Hatane, 2012). Raporda et al. (2005) Rao pesticide poisoning has reported nearly 3 million cases to nearly 220,000 deaths each year in nearly 75,000 chronic diseases.

2.3 Consequence of the Use of Pesticides

Pesticides which are utilized for preventing or destroying pests and diseases are having more negative effect on our environment when contrasted with its coveted activity. Pesticides are conveyed by wind movement to different territories, subsequently, causing air contamination. A few pesticides additionally cause water contamination while others are persistent organic pollutants which add to soil pollution (Deepa et al., 2011).

2.3.1 Soil Contamination

A major portion of the pesticides that is utilized for agriculture and different purposes accumulates in the soil, whose effect may continue for a considerable length of time and adversely affect soil conservation (Gill and Garg, 2014). Pesticides enter the soil by means of spray drift during foliage treatment, wash-off from treated foliage and wrong disposal of any remains of the pesticide, spray wash water and container. Pesticides deposited in the soil can be directly dangerous to soil arthropods and soil microorganisms. This outcome has a negative effect on their exercises (i.e. behavior, metabolism, reproduction and decomposition) which weakens and changes the soil microbial diversity and microbial biomass, in the long run prompting influence in soil ecosystem and loss of soil fertility (Handa et al., 1999; Sofo et al., 2012; Gill and Garg, 2014). Reinecke and Reinecke (2007) stated that earthworm were affected negatively because of chronic and intermittent exposures to chlorpyrifos and azinphos methyl, respectively.

As indicated by Hussain et al. (2009) and Munoz-Leoz et al. (2011), pesticides in soils may likewise unfavorably influence the soils fundamental biochemical reactions including nitrogen fixation, nitrification, and ammonification by activating/deactivating particular soil microorganisms and additionally enzymes engaged in the process. The insectidies DDT, methyl-parathion and particularly pentachlorophenol have been appeared to meddle with legume-rhizobium chemical signaling. Reduction of this symbiotic chemical signaling outcome in lessening nitrogen fixation and accordingly, decreased harvest yields.

Pesticides that reach the soil may likewise distort common metabolism or can modify the soil enzymatic activity (Gonod et al., 2006; Floch et al., 2011). Soil, generally contains an enzymatic pool which involves free enzymes, immobilized extracellular enzymes and proteins discharged by (or inside) microorganisms that are pointers of biological balance or equilibrium including soil fertility and quality (Mayanglambam et al., 2005; Hussain et al., 2009). Degradation of the two pesticides and natural substances in soil is catalyzed by this enzymatic pool (Floch et al., 2011; Kizilkaya et al., 2012).

Glover-Amengor et al. (2008) and Nuertey et al. (2007) in their examination on the impact of excessive utilization of pesticides on biomass and microorganisms in oil palm and vegetable agro-biological systems in Ghana, noticed that pesticides restrain bacterial populace bringing about inhibited nitrification and blockage of other soil microorganisms of both natural and inorganic constituents in the soil, subsequently, diminishing the soil fertility. It was additionally uncovered that pesticide application highly affected fungal populace.

2.3.2 Contamination of Water

Pesticide deposits in water are a major issue of concern as they represent a serious risk to the ecosystem including humans (Gill and Garg, 2014). As indicated by Carvalho (2006) and Camargo and Alonso (2006), huge utilization of pesticides has caused genuine contamination of aquifers and surface water bodies, diminishing the nature of water for human utilization. Pesticides applied in the environment can get into water bodies (surface and groundwater) by means of drift when spraying of the pesticide, by run-off from treated zone, by disintegrating soil, atmospheric fallout, wrong transfer of pesticide wastes, accidental spillage or through disregard, washing of spray equipment like the knapsack sprayer after use and percolation or leaching through the soil profile (Papendick et al., 1986; Singh and Mandal, 2013). When pesticides enter water bodies, they can possibly cause harmful impacts on human health when consumed in any form, on aquatic living organisms, and can cause disturbances of the aquatic biological systems.

In Italian forests, inappropriate utilization of pesticides and its dynamic metabolites has prompted the pollution of water bodies perhaps influencing the health of aquatic biota fishes and amphibians (Trevisan et al., 1993). Research by the UK government demonstrated that pesticide concentrations exceeded those allowable for drinking water in some samples of river water and groundwater (Bingham, 2007). Essentially, water samples from rivers in the concentrated cocoa developing regions in the Ashanti and Eastern Regions of Ghana have been found to contain lindane and endosulfan (Acquaah, 1997). Likewise, report by Darko et al. (2008), Kuranchie-Mensah et al. (2012) and Gbeddy et al. (2015) which studied organochlorine pesticides in water samples from Lake Bosomtwi, Densu waterway bowl and Volta Lake in Ghana, separately.

2.3.3 Contamination of Air

Pesticides can add to air contamination. This happens when pesticides suspended in the air during and after application as particles are conveyed by air to different zones conceivably causing pollution (Deepa et al., 2011). The deposition of pesticides in the air can be caused by various variables including spray drift, volatilization from the treated surfaces, through breeze disintegration of contaminated soil particles, and aeronautical use of pesticides (Tiryaki and Temur, 2010; Gill and Garg, 2014). Pesticides in air represent a danger to wildlife, the environment (as droplets settle down on soils and water bodies far from the site of utilization of the pesticide) and human health when breathed in (Tiryaki and Temur, 2010). As indicated by Armstrong et al. (2013), organophosphorus (OP) pesticides were distinguished from environmental samples of air following agricultural spray applications in California and Washington (USA). Additionally, Hogarh et al. (2014) have covered the event of organochlorine pesticides (OCPs) in air tests from Ghana.

2.3.4 Effects on Health

Pesticides can enter the human body by direct contact with chemicals, through food particularly vegetables and fruits, polluted water or air (Ye et al., 2013). Both acute and chronic diseases can come about because of pesticide exposure, as described below.

2.3.4.1 Acute Illness

Acute illness generally appears a short time after contact or exposure to the pesticide. Pesticide drift from agricultural fields, exposure to pesticides during application and deliberate or unexpected poisoning, leading to the intense illness in people (Dawson et al., 2010; Lee et al., 2011). An acute illness is generally regarded as an illness that occurs within the few days after exposure, usually less than two weeks. Headaches, body aches, skin irritation, respiratory problems, skin rashes, poor concentration, nausea, fatigue, diarrhoea, vomiting, throat and lung irritation, dizziness, impaired vision, cramps and panic attacks are symptoms that can occur due to acute pesticide poisoning (Pan-Germany, 2012; Gill and Garg, 2014).

The seriousness of the side effects related with pesticide poisoning is because of the poisonous quality of the chemical, method of activity, method of utilization, the length/duration and greatness of exposure, the kind of pesticide, measurements, timing, and the vulnerability of the exposed individual (Lioy, 2006). The Northern Presbyterian Agricultural Services (NPAS) (2012) revealed that the most widely recognized intense ailment experienced by Ghanaian ranchers amid and after the utilization of pesticides included disturbance, cerebral pain, general body shortcoming, trouble in breathing and tipsiness. So also, rancher's field reviews done by Mensah et al. (2004) and in Ghana, distinguished headache, general weakness, dizziness, body pains, skin irritation, nausea, sneezing, abdominal pains, vomiting, fever, blurred vision, cough, itchy or watery eyes, stomachache, breathing difficulties, burning sensations and diarrhoea as acute poisoning indications through pesticides application.

2.3.4.2 Chronic Illness

Continuous exposure to quantities of pesticides during prolonged periods of time, results in chronic diseases in humans (Pan-Germany, 2012). The symptoms do not appear immediately and do not occur at a later stage. Farmers and their families are most exposed to the agricultural pesticide through direct contact with chemicals. However, the overall population is also affected by contaminated food and water or poison drugs (Deepa et al., 2011, Pan-Germany, 2012).

Different studies have chronic diseases linked to prolonged exposure to pesticides (Shim et al., 2009; Heck et al., 2010; Xu et al., 2010; Band et al., 2011; Cocco et al., 2013). Tanner et al., 2010), Parkinson disease, cancer, including childhood and adult cancer, renal cell carcinoma, lymphocytic leukemia, and prostate cancer (Shen et al. Alzheimer's disease (Elbaz et al., 2009, Bandai et al., 2011 2011), cardiovascular (Andersen et al., 2012), diabetes mellitus (type 2 diabetes) (Song et al., 2010). There was no significant difference in the incidence of menopausal disorders in women with menopause, and respiratory diseases (asthma, chronic obstructive pulmonary disease) (Chakraborty et al., 2009; Hopp et al. 2009, Ye et al., 2013).

In Ghana (2012), fifteen farmers of the NPAS reportedly died of Upper Suspected pesticide poisoning in the Eastern Region in late 2010, as pesticides, food stocks and from poor storage. Gerken et al. (2001), three Ghanaian children lost their lives in March 1999, eating high carbide carbamate-bearing fruit.

2.4 Pesticide and Spray Drift Regulation

In the first century, the Romans conquered cities and areas of the enemy and wanted to prevent agriculture by humiliating them. From modest beginnings, the pesticide industry has evolved into a highly specialized, multi-billion dollar production with $ 4 billion reportedly pesticide-driven by annual sales in the United States alone (Cooper and Dobson, 2007).The widespread use of pesticides in the US was due to an aftermath of post war on agriculture, the Second World War started shortly after. In 1959, a farmer could partake of 50 people who could be fed by a single farmer and in 2000 about 120 people (Stone, 2008). This is mainly due to an increased use of pesticides. Aesthetic appeal is increasing in lawns and horticulture (Pimentel et al., 1992), used every year, with benefits ranging from pesticides to more than 550,000 tonnes of financial returns when used on crops four times or $ 16 billion (Cooper and Dobson , 2007).

Early regulation could lead to the establishment of the 1910 Federal Insecticide Act. This process was managed by the US Department of Agriculture (USDA) to create a standard pesticide that protects farmers from purchasing a counterfeit or modified insecticide. At the moment, little was known about pesticide effects in humans or the environment. Only until 1938 the USDA's first bill made an arrangement to protect people from pesticides. Production of pesticides and the use of pesticides as the first synthetic organic pesticide. In 1947, the fungicide and rodenticide Act (FIRA) was introduced, creating a new, original federal law to control the regulation of pesticides by law on pesticides. In particular, FIRA initiated and controlled the pesticide application process.

In 1962 Rachel Carson, a scientist, published Silent Spring, is an environmental movement against pesticides.Carson explains the dangers of abusing pesticide and probably a worrying perspective and calling on the reform of methods used to pesticide (Delaplane, 1996). In 1964, FIRA was modified to require intensive pesticide testing prior to registration, as well as increased responsibility for pesticide producers. In 1970, the United States Environmental Protection Agency (US EPA), created by President Nixon as the single point of all environmental concerns, revisions and more stringent regulations are being supervised by FIFA, delivered by the USDA in the EPA. In this period, EPA changed the control of pesticides with a less proactive, more reactive stance in reducing unreasonable risks. The labeling becomes more prominent than the methods used for pesticide application. Implementation training programs for the education of the farmers were also established. The last major revision of the regulation of pesticides in 1996 is to ensure that the recording process does not create harmful organisms (Collins, 2005).

The spray displacement scheme falls in the methods used to contain a pesticide FIRA and require administration and EPA. (EPA, 1999) is created to prevent unreasonable adverse effects. The specific displacement label for each pesticide is appropriately assessed.

Pesticides (risk assessment), potential benefits, driftability, typical methods and practices, and environmental future toxicity are all considered in determining specific drag labeling. Inconsistent pesticide application with their labeling is the practice of federal law infringement and EPA displacement reduction methods. When the wind speed exceeds 10 ml / h, no specific shear sample is applied, it is applied using only a thick drop size. Most labels include a non-generic targeting language that should be avoided or prohibited. While EPA agrees that there will be any value change, practitioners are responsible for implementing all anti-slip measures to protect against excessive risks associated with labeling. EPA checks the violations in place, and the size, effect and measures taken by the applicator are handled appropriately.

In 2005, EPA reviewed the EPA, the Program for Pesticides Dialogue Committee (PPDC), a federal advisory committee composed of stakeholders on pesticides, to lighten the existing methods. Robust, inapplicable, confusing, application and / or contradictory (Spray Drift Workgroup, 2007) as PPDC flow labeling methods. In response to these negative reviews, EPA launched an investigation into current labeling methods in 2009. It aims to create more standard, concise, and applicable expressions that are directly related to the reduction in the size of the spot (Figure 2). In addition to providing more specific pesticide reduction diets, EPA has also recommended that you add the following expression: Do not apply this product in direct or sliding contact with workers or other persons. In addition, do not apply this product to humans or any other untargeted or potentially harmful spray or site (EPA, 2009). Adding this words to the pesticide is expected to give more jurisdiction over EPA's drift pesticide violations.

Figure 2.
EPA proposed drift-specific label displaying required buffer zones based on weather and application conditions

Ground Boom Sprayer Drift Requirements:

Nozzle height, droplet size, wind speed, and buffer zones between application sites and specified sensitive areas must be consistent with the following table:

Wind Speed	**Nozzle Height**	**Droplet Size (ASAE Standard 572)**	**Buffer Zone**
Less than ***X*** mph	Up to ***A*** feet	Medium or coarser	***D*** feet
	A to ***B*** feet	Coarse or coarser	***E*** feet
	B to ***C*** feet	Very Coarse or coarser	***F*** feet
X to ***Y*** mph	Up to ***A*** feet	Coarse or coarser	***G*** feet
	A to ***B*** feet	Very Coarse or coarser	***H*** feet
	B to ***C*** feet	Extremely Coarse or coarser	***I*** feet
DRT *			***J*** feet
DRT **			***K*** feet
DRT *** or higher			***L*** feet

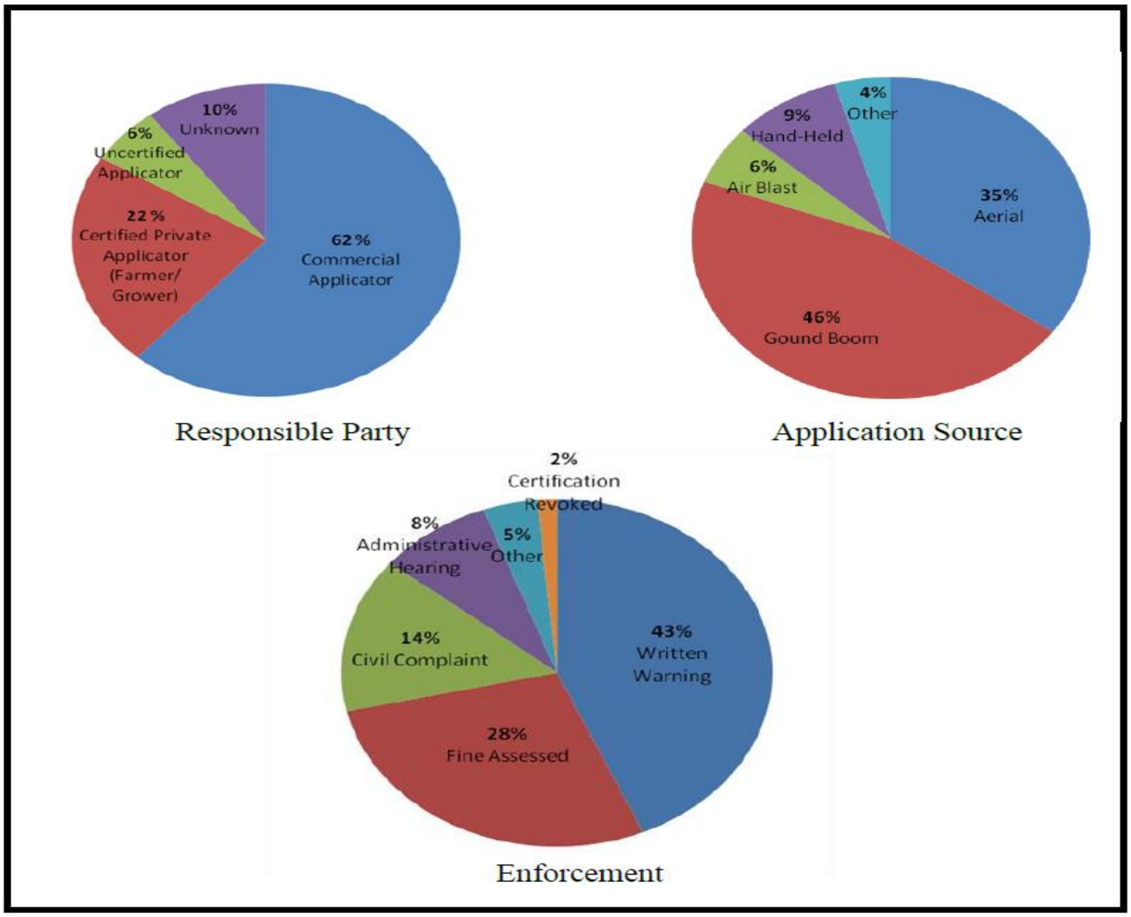
The applicator must consider equipment speed, nozzle angle, and pressure in determining droplet size.
Do not apply when the wind speed exceeds ***Y*** miles per hour.
Do not apply with a nozzle height of greater than ***C*** feet above the ground or crop canopy.
Do not apply within the buffer zone distance of the following sites: **[specify sensitive site(s) of concern specific to product]**.

2.5 Prevalence of Drift

2.5.1 Drift Statistics

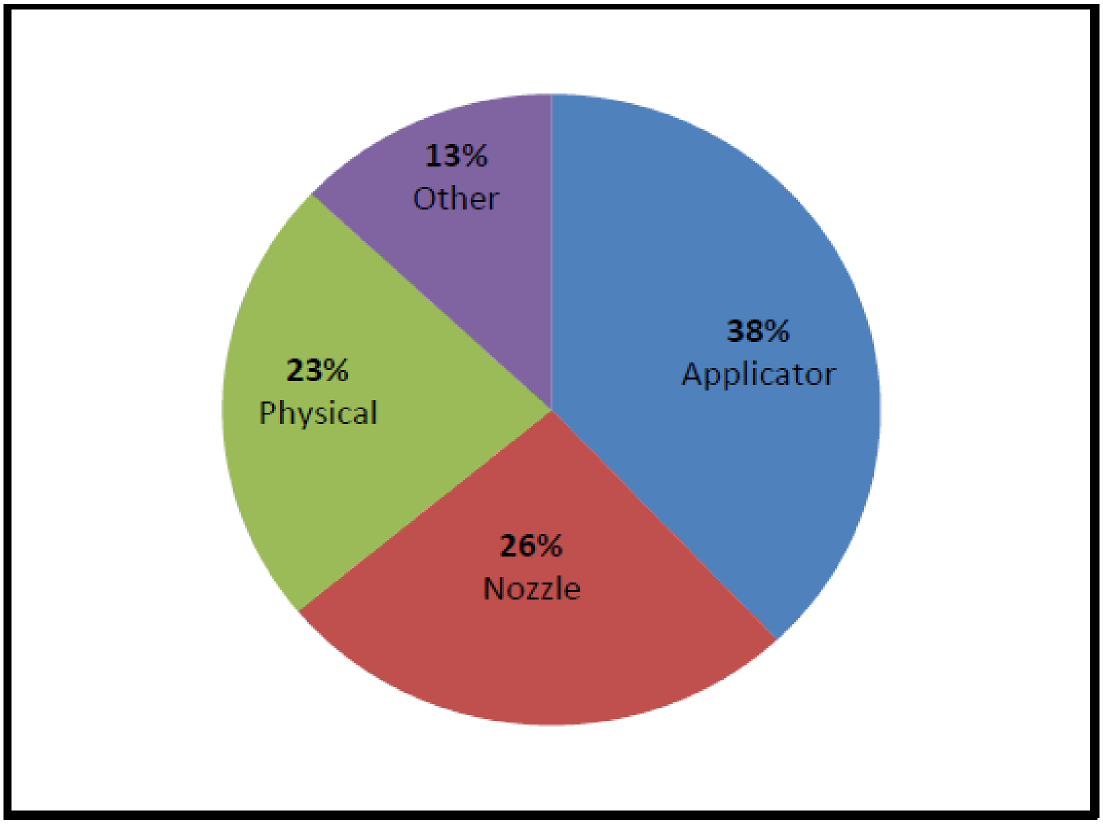
The Association of American Pesticide Control Officials (AAPCO) conducted a survey in 2005 to gain access to coverage and use of vehicle drifting violations. The State pesticide office is the first line of investigation and implementation of drift events; According to the survey results, in 2004, 1,705 complaints were reported concerning drifting ships. Figure 3 shows the effect of drift events and reported divisions of entities responsible for entrainment drift cases.

Figure 3.
Responsible party, source of drift, and enforcement of drift complaints distributions (AAPCO, 2005).



A summary of the determinants of the movement of insurance claims is provided by Farmland Insurance (Shaw, 1996). As Figure 4 shows the majority of the differential damage is due to the failure to take practical precautions to reduce the presence of practitioners. Poor or inappropriate selection of memories caused 26% of cases. The physical conditions of displacement are related to weather conditions such as high wind speed.

Figure 4.
Causes of drift cited in insurance claims (Shaw, 1996).



2.5.2 Magnitude of Drift

EPA created the Spray Drift Task Force (SDTF) in 1990 to conduct extensive field tests. The SDTF is made up of a variety of chemical companies interested in determining the environmental impacts of their products. Ten field studies were conducted with more than 300 applications on an experimentally defined large mobility database. The test results show the high effect of weather conditions, droplet size and area modulation on the amount of displacement over the area boundaries. The best management authorities (low boom height, large droplet size, and low wind speeds) leave the test field limits at 0.5% of the applied volume when the deviation is maintained during the tests. As expected, the area size increased with the percentage of area in the field. In the slip motion, the offset shift slip is generally regarded as the maximum negative impact on the environment and is the issue of most regulatory action.

Most independent investigators have studied the magnitude of displacement occurring in typical spray events on the field. Grover et al., (1997) conducted a field test using a sprayer with three different tips under a spracoupe® (AGCO, Duluth, GA) changing the wind speeds to determine impact droplet size and Drift wind speed.

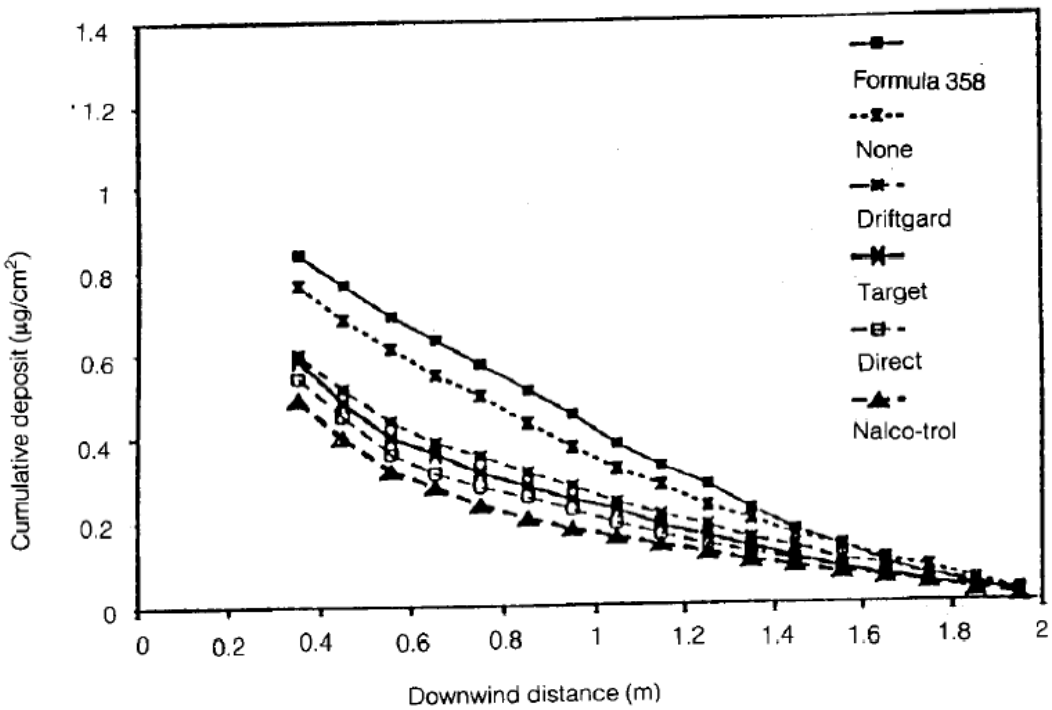
Drift was quantified as a percentage of applied volume driven from the side of the arm for only one direction of the wind, and gave the concept of a deviation as well as the edge of an area. TeeJet XR 11002 Spraying Systems, Wheaton, IL) with a flat fan with low speed of wind (7.7 km / h), filtered through the edge of the boom 23.8% of the applied volume. Using the same wind speed (14.9 km / h) increased to 12.7%. The high wind speed (28 km / h) extends beyond the edge of the arc until the applied volume reaches 35.6%. Bateans et al. (2007), a measure of displacement at windward directions perpendicular to the sprayer path distances to obtain a deposition settling profile.

The settlements are expressed as a percentage of application rates at low wind speeds (2.2 m / sec) at 10, 1.8, and 1% at 0.5, 5, and 10 m distances from the sides of the column, respectively. The applied volume was 10.45% out of the layer, leaving 31.4% applied under high wind speed (3.9 m / sec).

2.6 Drift Reduction Technologies

Increasing regulation of spray drift has created a huge market for drift reducing vehicle technologies. The most basic approach to mitigation is to change the variables affecting the path of the droplet path. Droplet size, wind speed, and release rate have a great impact on break distance and are therefore a common change target. A study by SDTF showed that the only effect affecting droplet size displacement is the variable (SDTF, 1997). Not surprisingly, the droplet formation process is therefore the goal of drift reduction technologies. Objective drift reduction nozzles to reduce the volume ratio of smaller droplets to 150 microns (ie droplets with a higher drag-prone tendency). Almost every manufacturer has a form of reductive nozzle, spraying drift which can immediately use one of the methods to suck the air in a frontal hole or increasing droplet sizes. Pre-orifice nozzles in advance increase the turbulence-reducing droplet size to the exit velocity of the nozzle which are air-absorbing suckers mixed with liquid-producing droplets at air-to-liquid volume ratios of 12:22 to 12:22, with hollow droplets having larger diameters of 00:29 (Lafferty, 2001). Derksen et al.,(1999). Two of the most popular drift reductions are classified as being produced by the Turbo Teejet produced by Greenleaf's Technologies (Covington, LA) Systems and TurboDrop spraying droplets with very thin volume (<150 microns) reduced to the same nozzle size 31.15 and 8.63% to 52% (in a standard flat fan nozzle) and flow rate respectively, the drift reduction nozzles both have a larger droplet size for both sub-substantially less deposits (Figure 5).

Figure 5.
Comparison of downwind drift depositions for 5 drift retardants compared to water (Ozkan et al., 1995).



Although drift retarders have been tested in laboratory tests, the impact on the droplet size increases and the reduction in displacement in the field is still relatively uncertain. Zhu et al. (1997) found that delivery of liquids containing drag retarders to voltage retarders to be observed in a typical field spray pump reduces the retarding effect on droplet size. Once released several times on a pump, we found that 12 different observations were made.

Spray shields are trying to reduce the effect of wind speed on droplets by reducing deflection. This protective technique may be used for the spray boom as a whole or with separate nozzle shields. Wolf et al. (1993) found out that both protective methods were useful in reducing the likelihood of being displaced. Individual nozzle shields reduce displacement by 33% and reduce deflection by 85% while using a sheet shield to cover the whole arm. In addition, rising wind speeds have been found to have an impact on unbalanced rigging applications.

Air assist systems and electrostatic spraying have become increasingly popular for practitioners who want to reduce drifting movement while producing better cover pages for increased activity. Air assist systems are incorporated into the air flow system to establish a controlled airspace captured by droplets between the nozzle and the plant canopy. The drift area consists of high velocity air streams perpendicular to the ground. Electrostatic sprayers apply a positive load to the liquid, so they are attracted to negatively charged plants. It is generally considered that each of these systems will reduce drag traffic. The study by Storozynsky (1997) found out that the air-powered system actually reduced the air drift by 50% (compared with a standard system) of electrostatic sprayers, which in fact increased by 5%.

2.7 Pesticides Application and Application Equipment

This refers to practical ways in which pesticides are distributed to biological targets such as harmful plants, plants or other plants. The effects of pesticides on humans and the environment have recently made it necessary to use them effectively (operators, duties, consumers) to minimize environmental and human exposures.

Pest control application methods apply pesticide seed and spray application methods and techniques, pesticides, weather and application equipment (US / CDC, 2000) is applicable to seeds prior to planting or seed treatment. This protects seeds / plants from threats from the ground. The harmful challenge role of pesticides does not emphasize a significant area of equipment and technique used for pest control and consequently for better product yields. Pesticide application is not limited to the operation of the application equipment together with the excellent knowledge of this pest management, in order to meet the target cultures with maximum performance, minimum effort and minimum contamination of crops to the outside target to keep harmful under control.

A good pesticide application technique is important at first. It should not be forgotten that all pesticides are toxic and may damage living bodies and are used with great care. The most important reason for this is that the implementation is aimed at non-targeted safety and environmental goals (Pal and Gupta, 1996). In this article, we propose a new methodology to solve the parasite problem. At the same time, aims to prevent contamination. It is to be understood that pest control success depends on the quality of application, timing of application, application and coverage of pesticides applied uniformly when the target value is attained by applying appropriate droplet size and density to provide a suitable dosage of toxicant. Pesticides are dispersed by different methods such as spraying or dusting. Most insecticides are applied as a spray in a liquid formulation (dilution) with water or oil. The spray diluent can be produced as high, low or very low volume. One of the most common forms of pesticide application is the use of mechanical sprinklers.

These can be operated manually or with force. Manual atomizers include pump syringes/ syringes, stirrup pumps, Knap bag / shoulder joint (operating arm, piston pump, diaphragm pump, and static type compression sprayer (Pal and Gupta, 1996).

Most pesticides are diluted with water-applied water condensates through a very small opening for a nozzle to create a targeted spray on the intended surface (Matthews, 2015). The original backpack sprayer was a manual pump that was part of a small tank passed back to the user. Backpack sprayer (Figure 2.6 and 2.7) is the most used arm, designed as liquid spray instead of air. It is suitable for small farms and areas without access to vehicles and is designed to meet FAO international standards. The sprayer is mounted behind a controller with a pair of coupling straps. The sprinkler pump is activated with one hand up and down with a manual lever. The liquid reservoirs consist of a hydraulic pump, a control rod, a pressure chamber, a mixer, a distribution pipe, a spray nozzle and a nozzle. Usually a plastic tank with a capacity of 14-16 liters is used. It is necessary to operate the control arm at 15-20 strokes per minute.

Figure 6.
A lever operated Knapsack sprayer.

Figure 7.
Backpack Sprayer

Spraying field crops in areas where the land is unusable or where there is a motorized blowout sprayer is a cost-effective and manageable way and may not be suitable for this job - using a spray for a backpack. They are ideal equipment for spraying small areas under crops or where there is no space for mechanical sprayers. When properly calibrated and maintained, it can provide a long and useful life and provide accurate spraying and successful plant protection. In most cases, field crops usually cover an area of 0.8-2.0 hectares per working day (Pal and Gupta, 1996).

CHAPTER III
METHODS

In this chapter the details of different methods used in this study will be examined in terms of data collection, application of the collected data tools, and data analysis which is carried out to assess the raising efficiency of farmers to improve environmental awareness in the use of pesticides and agricultural machinery used to spray pesticides and their environmental impact in the east of Tripoli, Libya.

3.1 Research Model

This study mainly focuses on determining the efficiency of farmers to improve environmental awareness in the use of pesticides and agricultural machinery used to spray pesticides and their environmental impact in the east of Tripoli, Libya. This study is based on field study carried out in East Tripoli, Libya in 2018. The method applied in this study to make it more reliable is quantitative method by use of research questionnaire adopted from Amber et al., (2017) and from sources like articles, textbooks, and studies on the subject and internet source.

3.2 Participants and sample

The study was carried out in the East part of the Tripoli. The study is a cross-sectional one among 300 farmers dwelling in the community of Tripoli district of Libya. This study concentrated on the adult population. An eligible criteria used in this study include (i) The farmer being above 18 years (ii) a permanent resident in the study area and (iii) the respondent’s willingness to be obliged to the study protocols and complete the study.

Every farmer was given an organized questionnaire. The questionnaire focused on gender, age, education, information about the type of crop sprayer, purchasing agricultural chemicals storing protective chemicals, personal Protective Equipment PPE, spraying plants and vegetal products, misapplication of protective products and quality of machinery for spraying (See detailed questionnaire).

Table 1 and figure 8 indicate demographic structure of the participants. 154 (51.3%) of the farmers specified that they were full-time professional farmers. 146 (48.7%) reported that they were in full-time professional farming. Also, 166 (51.25%) of the farmer were male while 134 (48.7%) were female. As for their educational level, 29 (9.7%) farmers did not attend school, 104 (34.7%) attended high school, 151 (50.3%) completed college. Only 5 (5.3%) of the farmer were university graduates. 59 (19.7%), 124 (41.3%) and 62 (20.7%) of the farmers were between the ages of 20 - 30 years, 31 - 40 years and 41 – 50 years respectively. 55 (18.3%) were above 50 years. In addition, 33 (11.0%), 92 (30.7%), 142 (47.3%) and 33 (11.0%) of the farmers were found in Tripoli, Misurata, Alzaweya and Zliten districts respectively.

Figure 6.
Demographic distribution of the study

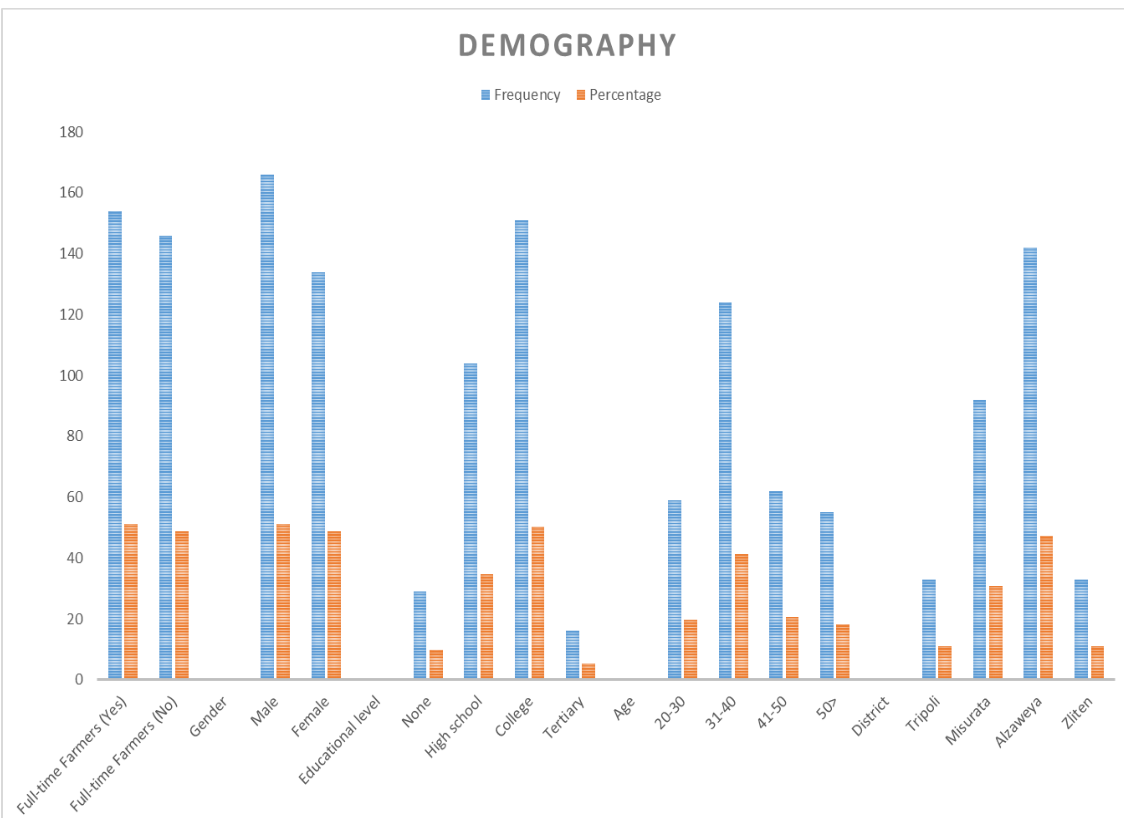


Table 1.
Demographic distribution (n = 300)

Demographic category	**Frequency**	**Percentage**
Full-time professional farmer		
Yes	154	51.3
No	146	48.7
Gender	**Frequency**	**Percentage**
Male	166	51.25
Female	134	48.75
Educational level	**Frequency**	**Percentage**
None	29	9.7
High school	104	34.7
College	151	50.3
Tertiary	16	5.3
Age	**Frequency**	**Percentage**
20-30	59	19.7
31-40	124	41.3
41-50	62	20.7
50>	55	18.3
District	**Frequency**	**Percentage**
Tripoli	33	11.0
Misurata	92	30.7
Alzaweya	142	47.3
Zliten	33	11.0

3.3 Data Gathering Tools

In this study the data collection tools used were personal information, environmental awareness, knowledge and behavior scale test and information test.

3.4 Scoring Scale Classification of the Substance

The efficiency of farmers to improve environmental awareness in the use of pesticides and agricultural machinery used to spray pesticides and their environmental impact in the East of Tripoli, Libya were revealed according to the interpreted based on the survey questions.

3.5 Data Analysis

The data were encoded and statistical analyses were accomplished using SPSS statistical software. Percentages were based on the number of respondents rather than using the total sample. The efficiency of farmers improved environmental awareness in the use of pesticides and machineries used to spray pesticides were determined statistically by means of t-test, ANOVA and descriptive statistics.

3.6 Research Ethics

For the research to be reliable, validity and scientific process research ethics were considered. The participants were give direct questions. The researcher actually demonstrated an objective attitude during the research by demonstrating a good work behavior in order not to influence the study.

CHAPTER IV
RESULTS AND DISCUSSION

A quantitative research approach was used to achieve the aims of the study. This chapter includes the general information and the statistical analysis of the data collected according to the research procedures described in Chapter 3.

Table 2.
Distribution of Product, Market and district

Selling production in market	**Frequency**	**Percentage**
No	176	58.7
Yes	124	41.3
50% of annual income	**Frequency**	**Percentage**
Yes	178	59.3
No	122	40.7
Plant and vegetable product	**Frequency**	**Percentage**
Orchards	17	5.7
Potatoes	19	6.3
Vineyard	54	18.0
Vegetables	114	38.0
Cereal	96	32.0

In Table 2, 176 (58.7%) of the farmers reported that they sold their products in market, but 124 (41.3%) expressed that they did not sell the product in the market. Furthermore, the farmers were asked whether the income from the agricultural selling product was 50% equal to their annual income. 178 (59.3%) responded as “yes”, less than half of them 122 (40.7%) said “no”. Also, 17 (5.7%), 19 (6.3%), 54 (18.0%), 114 (38.0%) and 96 (32.0%) of the farmers dealt with orchards, potatoes, vineyard, vegetable and cereal products respectively.

Table 3.
Information about the type of crop sprayer

Type of sprayer	**Frequency**	**Percentage**
Backpack sprayer	52	17.3
Skid-mounted sprayer	109	36.3
Irrigation boom sprayer	139	46.3
Total	**300**	**100**
Type of nozzle sprayer you use	**Frequency**	**Percentage**
Hollow cone nozzle (HC)	43	14.3
reflex nozzle	23	7.7
Adjustable nozzle	39	13.0
Other	195	65.0
Total	**300**	**100**
How long have you been using sprayer	**Frequency**	**Percentage**
< 5	70	23.3
6 - 10 year	74	24.7
11 - 20 years	86	28.7
> 20 years	70	23.3
Total	**300**	**100**
Do experts do maintenance	**Frequency**	**Percentage**
Yes	154	51.3
No	146	48.7
Total	**300**	**100**
How often do you calibrate	**Frequency**	**Percentage**
Every year	176	58.7
Every two years	124	41.5
Total	**300**	**100**
Who applies the spray	**Frequency**	**Percentage**
Myself	144	48.0
Servant	110	36.7
An expert or company	46	15.3
Total	**300**	**100**

Table 3 displayed information about the spraying of the crops. 52 (17.3%), 109 (36.3%), 139 (46.3%), 43 (14.3%), 23 (7.7%), 39 (13.0%), and 195 (65.0%) of the farmers reported that they used backpack, skid-mounted, irrigation boom, reflex nozzle, adjustable nozzles sprayers and others respectively. The farmers were asked how long they have applied the sprayers. 70 (23.3%) have used the sprayer less than 5 years, 74 (24.7%) have used between 11 to 20 years, 70 (23.3%) have applied the sprayers for more than 20 years. In addition, they were asked whether experts did maintenance. 154 (51.3%) agreed that experts did maintenance. But 146 (48.7%) disagreed that they did maintenance. Also, 176 (58.7%) said that they calibrated every year and 124 (41.5%) calibrated every two years. 144 (48.0%) applied the spray themselves and 110 (36.7%) employed servants to do it. Only 46 (15.3%) relied on an expert or company to spray the products for them.

4.1 Does Farmers' Knowledge about Safe Use of Personal Protective Equipment (PPE's) Protect Them from Health Effect?

Table 4.

Purchasing agricultural chemicals

Where do you buy the chemicals?	**Frequency**	**Percentage**
Licensed retail shops	154	51.3
Others	146	48.7
Total	**300**	**100**
How do you identify vegetal diseases?	**Frequency**	**Percentage**
I get help from the Office of Agriculture	43	14.3
I get help from Chemical sellers	41	13.7
I prepare myself	50	16.7
Others	166	55.3
Total	**300**	**100**
How do you select protective chemicals?	**Frequency**	**Percentage**
I get help from the Office of Agriculture	156	52.0
I prepare myself	110	36.7
Others	34	11.3
Total	**300**	**100**

Table 4 shows the result of purchasing agricultural chemicals. The farmers were asked where they bought the chemicals. 154 (51.3%) reported that they bought it from licensed retail shops, while 146 (48.7%) in other shops. Also, 43 (14.3%) suggested that they identity vegetal diseases by the help of the office of Agriculture, 41

(13.7%) from chemical sellers and 50 (16.7%) prepared by themselves while 166 (55.3%) used other options

Table 5.
Storing protective chemicals

Do you have a store?	**Frequency**	**Percentage**
Yes	211	70.3
No	89	29.7
Total	**300**	**100**
Do you keep the chemicals under lock?	**Frequency**	**Percentage**
Yes	235	78.3
No	65	21.7
Total	**300**	**100**
Do you keep chemicals in their original packs	**Frequency**	**Percentage**
Yes	201	67.0
No	99	33.0
Total	**300**	**100**

Table 5 displayed the result of storing protective chemicals. 211 (70.3) had stores to store their chemicals. Only 89 (29.7) did not have. In addition, 235 (78.3) reported that they kept the chemical under lock. Only 65 (21.7) did not keep it under lock. The farmers were also asked their kept chemicals in their original packs. 201 (67%) said “yes” while 99 (33%) indicated that they did not kept the chemical in their original pack.

Table 6.
Preparing the solution

Do you read the instructions before preparing the solution?	**Frequency**	**Percentage**
Yes	201	67
No	99	33
Total	**300**	**100**
Do you wear protective cloths while preparing the solution?	**Frequency**	**Percentage**
Yes	236	78.7
No	64	21.3
Total	**300**	**100**

Table 6 displayed how the farmers prepared the solution. 201 (67.0%) of the farmers reported that they read the instructions before preparing the solution, while 99 (33%) said they did not read the instructions. In addition, 236 (78.7) said that they wore protective clothes while preparing the solution. Only 64 (21.3%) did not wear protective clothes while preparing the solution.

Table 7.
Personal Protective Equipment PPE

Do you wear protective clothes?	**Frequency**	**Percentage**
Yes	207	69
No	93	31
Total	**300**	**100**
If you do, what type of protective clothes do you wear?	**Frequency**	**Percentage**
Fully protective	53	17.7
Filter face mask	31	10.3
Boots	53	17.7
Gloves	116	36.7
Others	34	11.3
Total	**300**	**100**
Length of use (yrs)	**Frequency**	**Percentage**
<3	43	14.3
4-5	41	13.7
6-10	50	16.7
11 above	166	55.3
Total	**300**	**100**

In Table 7, the farmers were asked about personal protective equipment. 207 (69%) said they wore protective clothes while 93 (31%) did not. Furthermore, they were asked to indicate the types of protective clothes they wore, 53 (17.7%), 31 (10.3%), 53 (17.7%), 116 (36.7%), 116 (36.7%) and 34 (11.3%) of the farmers wear fully protective, filter face mask, boots, gloves, and others cloths respectively. Furthermore 43 (14.3%), 41(13.7%), 50 (16.7%) and 166 (55.3%) of the farmers indicated that they have used the protective equipment for < 3, 4-5, 6-10 and 11 years above respectively

Table 8.
Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.645[a]	.416	.412	.37823	.416	105.757	2	297	.000	2.219

a. Predictors: (Constant), PS, SPC
b. Dependent Variable: Personal Protective Equipment (PPE's)?

The standard regression model summary (Table 8) indicates the value of the regression coefficiency (R =.645). This show how well all independent factors combined related with the dependent factor (Personal Protective Equipment). Additionally, the Adjusted R^2 = .412 shows that all the factors combine contributed 41.2% of the variances in the dependent factor personal protective equipment PPEs.

Table 9.
ANOVA[a]

Model		Sum Squares	ofdf	Mean Square	F	Sig.
1	Regression	30.259	2	15.129	105.757	.000[b]
	Residual	42.488	297	.143		
	Total	72.747	299			

a. Dependent Variable: Personal Protective Equipment (PPE's)

b. Predictors: (Constant), PS, SPC

Table 10.
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.311	.079		3.938	.000					
	SPC	.474	.108	.364	4.405	.000	.623	.248	.195	.288	3.472
	PS	.392	.105	.307	3.721	.000	.615	.211	.165	.288	3.472

a. Dependent Variable: PPEs protect?

From Table 9, Factor 1 (SPC) was statistically significant (B = -.364, t = 4.405; p = .000 < .05) and Factor 2 (PS) was also statistically significant (B = -.307, t = 3.721; p = .000 < .05) relate personal protective equipment PPEs. Therefore, farmers' knowledge about safe use of personal protective equipment PPEs protect them from health effect

4.2 Does Gender Influence the Awareness of Spraying Plant and Vegetal Products?

Table 11.
Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	62.933	.000	-45.218	298	.000	-.92537	.02046	-.96565	-.88510
Equal variances not assumed			-40.610	133.000	.000	-.92537	.02279	-.97044	-.88030

The independent sample t-test was used to test the hypothesis at a $p = 0.05$. The results are provided in Table 10. The t-test results, however, showed that there was statistically significant difference ($t(298) = 40.61$, $p < 0.05$) between male and female farmers' influence on the awareness of spraying plant and vegetal products. Therefore, gender influences the awareness of spraying plant and vegetal products.

4.3 Are the farmers' sensitive to the misapplication of protective product?

Table 12.

Result of misapplication chemical protective?

Phytotoxiciy on plants	**Frequency**	**Percentage**
Yes	192	64.0
No	72	24.0
I have no ideal	36	12.0
Total	**300**	**100**
Leftover on agricultural products?	**Frequency**	**Percentage**
Yes	150	50.0
No	105	35.0
I have no ideal	45	15.0
Total	**300**	**100**
Soil pollution?	**Frequency**	**Percentage**
Yes	158	52.7
No	96	32.0
I have no ideal	46	15.3
Total	**300**	**100**
Weed and harmful disease become durable against chemicals?	**Frequency**	**Percentage**
Yes	152	50.7
No	102	34.0
I have no ideal	46	15.3
Total	**300**	**100**
Acute, chronic poisoning in human?	**Frequency**	**Percentage**
Yes	156	52.0
No	85	28.3
I have no ideal	59	19.7
Total	**300**	**100**

Table 11, shows the results of misapplication of protective product. 192 (64%) of the farmers said they knew the results of misapplication of Phytotoxic Protective Products on plants, 72 (24%) did not know while 36 (12%) had no idea about it. Also, for leftover on agricultural products, 150 (50.0%) of the farmers knew the cause whilst 105 (35.0) did not know. Only 45 (15.3%) had no idea of leftover on agricultural products. In addition, 158 (52.7%) of the farmers indicated that they knew misapplication of chemical cause soil erosion, 96 (32.0%) did not know that. Only 46

(15.3%) had no idea. 152 (50. 7%) of the farmers knew that the weed and harmful disease become durable against chemicals. 102 (34.0%) did not know. Only 46 (15.3%) had no idea. Lastly, 156 (52.0%) of the farmers indicated that they knew misapplication of chemical cause Acute, chronic poisoning in human while 85 (28.3%) did not know that. Only 59 (19.7%) had no idea. From the above results, the majority of the farmers are aware of the cause of misapplication of chemical protective. Therefore, the farmers' are sensitive to the misapplication of protective product.

4.4 Does the Farmers' Education Level Affect Purchasing Agricultural Chemicals?

Table 13.
Correlations

		What is your education level	Where do you buy the chemicals?
What is your education level	Pearson Correlation	1	.000
	Sig. (2-tailed)		.993
	N	300	300
Where do you buy the chemicals?	Pearson Correlation	.000	1
	Sig. (2-tailed)	.993	
	N	300	300

Pearson Correlations of bivariate was used to examine any relationships between farmer educational level and the purchasing of agriculture chemicals. From Table 12, shows no correlation or relationship between farmers' educational level and purchasing of agricultural products. Therefore, the farmers' education level affects the purchasing agricultural chemicals.

4.5 Is PPEs Use Related With the Type of the Sprayer Used?

Table 14.
Correlations

		Type of sprayer?	Do you wear protective clothes?
Type of sprayer?	Pearson Correlation	1	-.027
	Sig. (2-tailed)		.642
	N	300	300
Do you wear protective clothes?	Pearson Correlation	-.027	1
	Sig. (2-tailed)	.642	
	N	300	300

Person Correction of bivariate (Table 13) was used to see if the PPE application was related to the type of sprayer used. Table 13, shows no correlation or relationship ($p > 0.05$) between farmers' application of PPE and the type of sprayer. Hence, PPEs use is not related with the type of sprayer.

4.6 Does Monthly Income Make Any Difference in the Use of Machineries Associated With Pesticide Application?

Table 15.
Monthly income on machineries

	Frequency	Percent	Valid Percent	Cumulative Percent
Weak	144	48.0	48.0	48.0
Medium	110	36.7	36.7	84.7
Excellent	46	15.3	15.3	100.0
Total	**300**	**100.0**	**100.0**	

Table 14 displayed information on how much savings in the amount of pesticide during use of machinery. 144 (48.0%) of the formers indicated that the monthly saving they used on pesticide was small or weak which did not affect their monthly income. 110 (36.7%) reported medium whilst 46 (15.3%) said excellent. This result suggested that monthly income does not make any difference in the use of machineries associated with pesticide application.

4.7 Are Farmers Aware of the Machineries Associated With Pesticide Application?

Table 16.
Modern machinery for spraying methods?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	176	58.7	58.7	58.7
No	124	41.3	41.3	100.0
Total	**300**	**100.0**	**100.0**	

Table 15 reveals farmers' awareness of modern machinery for spraying method. 176 (58.7%) of the formers reported that they were aware of modern machinery whilst 124 (41.3%) said they were not aware. This result suggested that the majority of the farmers are aware of the modern techniques and the machineries associated with pesticide application.

4.8 Do Farmers' Use Agricultural Machinery during Control Operations

Table 17.
Irrigation system during the process of spraying?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	200	66.7	66.7	66.7
No	100	33.3	33.3	100.0
Total	**300**	**100.0**	**100.0**	

As it can be seen in Table 16, farmers use irrigation systems during the process of spraying. 200 (66.7%) of them reported that they used irrigation systems during the process of spraying, whilst 100 (33.3%) said they do not use that application. This suggested that the majority of the farmers use irrigation system for sprayings process. This is the indication that farmers use agriculture machinery during control operations.

Table18.
Quality of machinery for spraying

What is the effect of machinery used in spraying on the surrounding environment?	**Frequency**	**Percentage**
Weak	144	48.0
Good	110	36.7
Very Good	46	15.3
How much savings in the amount of pesticide during use of machinery?		
Weak	144	48.0
Medium	110	36.7
Excellent	46	15.3
Are you using modern machinery for spraying methods?		
Yes	176	58.7
No	124	41.3
Are you using an irrigation system during the process of spraying?		
Yes	176	58.7
No	124	41.3
How bad is using the machines in spray process?		
Yes	144	48.0
No	110	36.7

Table 17 above displayed information about the quality of the machinery for spraying. 144 (48.0%), 110 (36.7%), and 46 (15.3%) showed the effect of machinery used in spraying on the surrounding environment. The farmers were asked How much savings in the amount of pesticide during use of machinery, 144 (48.0%) were weak, 110 (36.7%) were medium, and 46 (15.3%) were excellent. In addition, they were asked whether modern machinery were used for spraying methods or not 154 (51.3%) agreed that experts did maintenance. 146 (48.7%) disagreed that they did maintenance. 176 (58.7%) said “yes” and 124 (41.3%) said “no” to the of use method. 176 (58.7%) used irrigation system during the process of spraying and 124 (41.3%) did not use irrigation system during the process of spraying. 144 (48.0%) said using the machines in spraying process was bad and 110 (36,7%) said it was not bad.

CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In this study, the farmers in the East part of Libya earn 50% of their income by selling their farm products in the market which are mainly vegetables. In the East of Tripoli the sprayer use is adjustable nozzle sprayers and the majority of the farmers have used the sprayer for 11 - 20 years and they spray the pesticides themselves. This sprayer is maintained by experts, though its calibration of the sprayer is not done every year but every two years.

The research reveals that most of the farmers own a store to keep and protect their chemicals under lock in chemical original packs. For the farmers to know the hazards associated with the chemicals or pesticides to be used, the farmers read instructions before use and they wear protective clothes for the solution preparation which is similar to the study by Osei-Boadu (2014); Yeboah et al., (2004); Mensah et al., (2004) Sosan et al., (2008), Sosan and Akingbohungbe (2009), Ogunjimi and Farinde (2012) and Antwi-Agyakwa (2013) who reported that cocoa farmers interviewed wore protective clothing when spraying pesticides. The type of protective clothes the farmers in East Tripoli mostly wear are gloves and these type of PPE has been used for the past 11 years and above. There is a statistically significant and linear combination of independent factors significantly related to PPE's that protect the farmers from health effect and farmers' knowledge about safe use of PPE's protects them from health effect and this corresponds with the study conducted by Saowanee et al., (2010) which states that the associations between knowledge and attitude, knowledge and practice, and attitude and practice of farmers using pesticide demonstrated statistical significance. There is a statistically significant difference between male and female farmers influence on the awareness of spraying plant and vegetal plant and therefore gender influences awareness of spraying plant and vegetal products.

The majority of the farmers' have an idea of misapplication of pesticide product and this may result in soil erosion, weed and harmful disease may resist the chemical due to its misapplication and therefore, farmers knowledge affects misapplication of pesticide products. The farmers are sensitive to the misapplication of these products and according to FAO (2008), which states that there is a tendency of negative impact of every chemical substance or pesticides used in agriculture to the environment if improperly applied or used at high rates. This can be as a result of prolonged use of the same pesticide which can cause problems like pesticide resistance, a phenomenon consisting in the selection of resistant population of a weed. As specified by Pal and Gupta, (1996) it is imperative for farmers to have skillful dispersal methods and knowledge of the most susceptible stage of the pest thereby this will help them decide on the time of pesticide application.

There is no correlation or relationship between farmers' education level and purchasing of agricultural products. Therefore, farmer's education level affects purchasing agricultural products as cited by Croppenstedt and Muller (1998). Similar to this study Ethiopia Rural Household Survey (ERHS) indicates that there is no relationship between their level of education and agricultural output.

There is no correlation or relationship between application of PPE and type of sprayer. Therefore, PPE's use is not related with the type of sprayer. According to Ohayo-Mitoko et al., (1999) there is a significant positive relationship between awareness and use of protective level in the sprayer type used and then suggested that this may be due to discomfort associated with PPE while using sprayer. Some studies showed that although most of the farmers are aware of the importance of the use of protective measures when applying pesticides, there is still no significant positive relationship (Singh and Gupta, 2009). The result suggested that monthly income does not have any difference in the use of machineries associated with pesticide application.

The farmers are aware of modern machinery for spraying of pesticides and other researchers pointed out that farmers' and application equipment administrators' knowledge of the activity standards of pesticides and the right strategy for application is generally lacking or non-existing (Theodor, 2010). Much of the time they do not get any preparation/training on this issue (Heong et al., 1992). As of now at University level the theme is frequently ignored. In this manner, augmentation benefits regularly do not have experts with a specific knowledge of utilization of the technology. In numerous nations the main experts offering practical advice or consultancy to farmers on application technology, dealing with and adjustment of their equipment are delegates of pesticide organizations. However, they regularly do not have a characteristic enthusiasm for demonstrating to the farmer the proper methodologies to save real amounts of the item (pesticide). There are a few results of this absence of knowledge. Beginning with the choice of equipment, a farmer without specialized criteria will more often not pick the least expensive equipment, potentially the most strong. Parts of operator security, ease or effectiveness are of lesser significance, particularly if the equipment is not operated or handled by the farmer himself but by employed worker. Farmers use irrigation system during the process of spraying which indicates that they make use of agricultural machinery during control operations.

Application volumes of 6,000 l/ha in flowers and 10,000 l/ha in orchards have been reported (Wiles, 1994) causing run off of product and thus contaminating soil and probably groundwater resources. It is common that farmers and spray equipment operators still believe in high volumes, high pressure and high doses being perceived as the most appropriate ways for pesticide application thereby causing a run-off to the environment. A report from the Philippines demonstrates that a high number of farmers never show signs of change or fixing washers in their equipment which is related with the information of the working equipment (Withaker, 1993). Accordingly, most spray equipment spills. An investigation done in Indonesia detailed that 58% of manual spray equipment released (Hirschhorn, 1993). Information from Nicaragua affirm this perception, saying pesticide spills from operator has returned from spilling knapsack sprayers, being a common source of intoxications to the irrigation system (Matus and Beck, 1991).

5.2. Recommendation

The following recommendations are imperative to reduce the risk of pesticide usage:

- Farmers should be given training on the use of recent modernized spraying equipment with technical training on servicing them.

- Farmer education and knowledge on safe pesticide utilize ought to be strict to restrains the levels of pesticides deposits in drinking water sources, soils and agricultural produce as poor practices were seen from the investigation territory.

- Farmers must be taught on repercussion of the health dangers related with the different operational propensities they propagate while applying pesticides on their farms.

- Farmers must be urge to utilize the “on the spot spraying strategy” which is more cost effective, time and energy saving and does not debase environment in terms of draining into the water body or environment from irrigation systems used.

- Future monitoring projects are prescribed to get satisfactory data with respect to pesticide utilizing examples and levels of pesticides.

- Retailers may misuse the empty containers for decanting or repacking other agricultural products and it is recommended that all empty pesticide containers should be returned to manufacturers after use.

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Appendix- 1

QUESTIONNAIRE

Dear respondents

The objective of the questionnaire is to collect information about “*raising the efficiency of farmers to improve environmental awareness in the use of pesticides and agricultural machinery used to spray pesticides and their environmental impact in the east of Tripoli, Libya”*. The information you provide will be valuable for academic purposes of Near East University, Turkish Republic of north Cyprus TRNC. Therefore, your genuine, honest, and prompt response is a valuable input for the quality and successful completion of the research. The information you give will be used only for academic purpose and will be kept confidential.

I. The farmer and definition of farm

1. Sex: Male ☐ Female ☐

2. Age: 20-30 ☐ 31-40 ☐ 41- 50 ☐ 51 and above ☐

3. Educational level: None: ☐ High School: College: ☐ Tertiary: ☐

4. Are you a full-time professional farmer? Yes: ☐ No ☐

5. Do you sell your agricultural products in market? Yes: ☐ No: ☐

6. Does your agricultural income equal to 50% of your annual income?

Yes: ☐ No: ☐

7. District(s) Tripoli: ☐ Misurata: ☐ Alzaweya: ☐ Zliten: ☐

8. Plants and vegetable products Orchards: ☐ Potatoe: ☐

Vineyard: ☐ Vegetables: ☐ Cereal: ☐ Others: ☐

II. **Information about the type of crop sprayer**

9. Type of sprayer? Tower by tractor: ☐ Compressed air sprayer ☐

Backpack sprayer ☐ Skid-mounted sprayer ☐ Irrigation boom sprayer ☐

Central pesticide application system ☐

10. What type of nozzle sprayer do you use? (A) Hollow cone nozzle (HC) ☐

(B). reflex nozzle ☐ (C). Adjustable nozzle ☐ (D). Other ☐

11. How long have you been using sprayer? <5 yrs. ☐ 6-10 yrs. ☐ 11-20 yrs. ☐ > 20 yrs. ☐

12. Do experts do the maintenance? Yes: ☐ No: ☐

13. How often do you calibrate? Every year: ☐ Every two years: ☐

14. Who applies the spray? Myself: ☐ The servant: ☐

An expert or the company: ☐

III. Purchasing agricultural chemicals

15. Where do you buy the chemicals? Licensed retail shops: ☐ Others ☐ (specify):

16. How do you identify vegetal diseases? I get help from the Office of Agriculture: ☐

I get help from Chemical sellers: ☐

I prepare myself: ☐

Others (specify): ☐

17. How do you select protective chemicals? I get help from the Office of Agriculture:

I prepare myself: ☐

Others (specify): ☐

IV. Storing protective chemicals

		Yes	No
18.	Do you have a store?		
19.	Do you keep the chemicals under lock?		
20.	Do you keep chemicals in their original packs?		
V. Preparing the solution			
21.	Do you read the instructions before preparing the solution?		
22.	Do you wear protective cloths while preparing the solution?		

23. How do you measure the dose? I use a scale: ☐ I estimate the amount: ☐

VI. Personal Protective Equipment PPE

24. Do you wear protective clothes? Yes: ☐ No: ☐

25. If you do, what type of protective clothes do you wear? Fully protective: ☐

Filter face mask: ☐ Boots: ☐ Gloves: ☐ Others (specify): ☐

26. Length of use (yrs) < 3: ☐ 4 – 5: ☐ 6-10: ☐ 11 and above: ☐

VII. Spraying plants and vegetal products

27. Do you read the instruction before application? Yes: ☐ No: ☐

28. Do you follow the instructions? Yes ☐ No: ☐

29. Do you know how to apply the chemicals well? Yes: ☐ No: ☐

30. How do you dispose of the waste? I use it on plants and vegetal products: ☐

I pour it onto soil: ☐ Others (specify): ☐

31. Where do you clean the sprayer? Usually on the spot near water supplies: ☐ Usually where I keep it: ☐

32. How do you dispose of the emptied chemical containers? Bury them: ☐

Burn: ☐ Them: ☐ Other (specify): ☐

33. Do you have any idea about maximum waste limit? Yes: ☐ No: ☐

34. What other applications do you have except chemicals?

Cultural measures: ☐ Biological measures: ☐ Biotechnical measures: ☐

Physical measures: ☐

Others (specify): ☐

35. Do you follow the harvesting intervals? Yes: ☐ No: ☐

VIII. Misapplication of protective products

	Which of the following is a result of misapplication chemical protective?	Yes	No	I have no idea
36.	Phytotoxiciy on plants			
37.	Leftover on agricultural products			
38.	Soil pollution			
39.	Weed and harmful disease become durable against chemicals			
40.	Acute, chronic poisoning in human			

IX. Quality of machinery for spraying

41. What is the effect of machinery used in spraying on the surrounding environment?

Weak ☐ Good ☐ Very good ☐

42. How much savings in the amount of pesticide during use of machinery?

Weak ☐ Medium ☐ Excellent ☐

43. Are you using modern machinery for spraying methods?

Yes ☐ No ☐

44. Are you using an irrigation system during the process of spraying?

Yes ☐ No ☐

45. How bad is using the machines in spray process?

Good ☐ Bad ☐ Too Bad ☐

Curriculum Vitae

My name is; Ismail ATAHER ALBAKOUSH. I was born in 20/4/1984 in Tripoli/ Libya. In 2001, I started high school and completed in 2004, and began to study at the Higher and Intermediate Institute for agriculture Technology of Ghiran /Tripoli. I have been awarded the Higher Diploma in the Agricultural Science Technology. Specializing in Institute of Agricultural Technology specializing in Agricultural Machinery Technology with a general grade (Good) and an average (65.72%). For spring semester for the academic year (2007). I have appointed as a teaching assistant 2008. I have been nominated to study abroad for a master's degree by the admiration of the higher and intermediate of agriculture technology of Ghiran / Tripoli. I studied the English language in United Kingdom (UK) and afterword I had the opportunity to travel to the Republic of Northern Cyprus to get a good education in this country. My master began (2016) in the field of management science and environmental education at Near East University.

Thesis

ORIJINALLIK RAPORU

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