

# Pesticide Use and Risk Factors among Pest Exterminators and Farmers in the Greater Accra Region, Ghana

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## Abstract

Spraying of chemicals is essential as weapon for destroying pests, insects and diseases that are inimical to crops, animals and human beings as they destroy people's fortunes. While protecting the food system and properties, exposure to chemicals often impact negatively on the health of farmers and pest exterminators when precautionary measures are not taken seriously by pest applicators. In this regard, the objectives of this study were to: identify hazards faced by farmers and commercial pest exterminators; assess conditions that increases the risk of pesticide exposure on the part of farmers and pest exterminators; and examine the health hazards associated with spraying chemicals. Findings of the study identified different types of hazards such as itchy eyes, skin irritation and heavy breathing when protective equipment is not worn by farmers and pest exterminators. The study concludes that pesticide risks are high when protectives are not used in enclosed environments over long hours of spraying.

**Keywords:** Pesticide use • Risk factors • Pest exterminators

## Introduction

Pests have been terrors that terrified humans and caused havoc to properties, farm products and livestock [1]. In response to the terrific effects of pests, pesticides have been developed and used thousands of years ago to control pests [2]. Global use of pesticides have increased considerably over the past sixty years, with approximately 2.3 million tons of industrial pesticides used annually [3]. Pesticides are chemical compounds used to kill pests, such as insects, rodents, fungi and unwanted plants (weeds) [4]. Pesticides are not always meant to kill pests but to sometimes repel pests and alter their genetic makeup to reduce or eliminate their ability to reproduce [5]. In view of the health risks associated with pesticides they are manufactured under very strict regulations as they are dangerous when pesticide residues enter food and water [6]. The quantity of pesticides used in Sub Sahara Africa is said to be on the increase due to the expansive agricultural activities undertaken by 70% of the population that are into agriculture and use agro chemicals [7].

The deleterious effects of exposure to chemicals by farmers, traders and consumers, who are involved in the food supply chain are enormous [8]. The health risks are equally high for the handlers of pesticides such as workers applying pesticides on farms and parks, those who package the pesticides as well as those who are involved in commercial pest-control activities [9]. The health risk of pesticides is a function of pesticide toxicity such that a farmer who applies pesticides once a year will have lower risk of exposure than a commercial applicator who applies pesticides many consecutive days or weeks in a farming season [6]. Exposure to pesticides cause three major effects on those exposed to the chemicals which are acute, delayed and chronic effects [10]. Acute effects are risks related to symptoms of numbness,

tingling sensation, lack of coordination, headache, dizziness, tremor, nausea, abdominal cramps, sweating, blurred vision, difficulty in breathing or respiratory depression, and slow heartbeat [10]. Chronic poisoning occurs when people are repeatedly exposed to toxic agents for a longer period and the victims progressively become ill over a period of months or even years. In this period of time victims experience impaired memory and concentration, disorientation, severe depression, irritability, confusion, headache, speech difficulties, and insomnia [10]. The third effects are mainly allergic effects that include asthma, shock, skin irritation, such as rash, blisters, or open sores, and eye and nose irritation including sneezing [10].

In spite of all the risks associated with such chemicals many pesticide users in Ghana, who are farmers and unlicensed pest exterminators are not skilled in the application of such chemicals hence expose themselves to chemicals especially internationally banned and restricted pesticides [11]. Most of the studies done on pesticide use in Ghana focus on pesticides use by farmers with little or no attention paid to pesticide use in hotels, schools, hospitals, residential buildings, banks and other commercial offices for the purpose of combating the growing pest problems of today. These applicators engage in high risk practices when they fail to wear Personal Protective Equipment (PPEs) and mix pesticides with their bare hands [12,13]. This risk factors are important to be investigated as many fumigation firms have sprung up in the country and majority of them are in Accra which is the study area. The study therefore compared the risk factors of pesticide application by commercial pest controllers and farmers in Accra the capital city of the Greater Accra Region.

## Study area

The study was conducted in the Greater Accra Metropolitan area spanning approximately 225.67 km<sup>2</sup> (Ghana Statistical Service, 2019). The geographic location of Accra is 5°36'13.38"N, 0°11'13.07"W which is along the Gulf of Guinea. The Accra Metropolitan areas cover communities such as East Legon, McCarthy Hill, Dansoman, Osu, Nungua. These are not areas know for extensive farming but vegetable farming that takes place on small pockets of land found at residential and industrial areas and along the banks of rivers, streams and drains (Figure 1) [14,15].

## Conceptual framework

The conceptual frame work shows the sources of chemical risks and the levels of exposure that people who apply the chemicals on farms and pest exterminators get exposed to (Figure 2) conceptual frame work. Toxicity refers

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Figure 1. Map of Accra Metropolis (Source: Google Earth Pro, 2015).

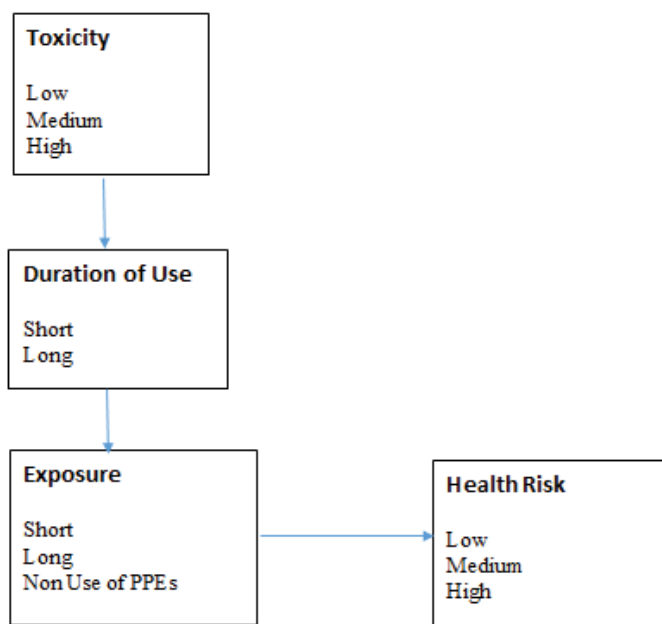


Figure 2. Conceptual framework.

to the concentration of chemical elements used to produce pesticides or herbicides to make the chemicals effective. The toxicity exist in levels such as high, moderate and low toxicity [16]. High toxicity concerns chemicals that have high concentration of active ingredients to deal with pests and diseases such as Calcium cyanide, parathion and Nicotine. Moderate toxicity refers to pesticides or herbicides that do not have high concentration of toxic chemical in the pesticides and herbicides such as Atrazin, Borax, Glyphosate and Chorpyrifos methyl [16]. Low toxicity refers to chemicals that have low toxin concentrations that do not pose serious health threats to people applying them [17].

Exposure refers to the extent of time or period such as number of hours persons applying the chemicals work to complete their task, a period long enough for the chemicals to be inhaled, and touch the skin of the applicator. Exposure also refers to working without protective gears. Long duration of chemical application means number of years a person has been applying pesticides/ herbicides. It also includes the number of hours the work takes to be completed. Long periods in this context refers to people applying chemicals for one year and more and those who apply chemicals more than 1 hour per section. Short duration refers to people who apply chemicals in less than one hour a day to get their jobs done.

Health risks could be low, moderate and high depending on whether protective cloths are worn or not and also the number of hours or years people applying chemicals have worked without any protection from exposure to pesticides. Risks are also encountered when people applying chemicals cannot

read and understand the safety instructions on containers. Furthermore, wrong disposal of containers such as leaving the containers in the open space for adults and children to pick up and wash for use as water containers.

## Methodology

In view of the scattered nature of the work of pest exterminators and location of vegetable gardens, convenient sampling technique was used for selecting farmers and pest control firms for interviews and observation. A list of licenced pest control firms were obtained from the Environmental Protection Agency. Purposive and convenient sampling techniques were used to select 50 farmers and 50 pest exterminators for the survey. Purposive sampling was used to select experts such as the head of Department of the Environmental Health Unit of the Korle-Bu Teaching Hospital, experts from the chemical division of the Environmental Protection Agency. Questions posed to these experts were on health risks associated with pesticide application, their symptoms and treatments.

Data collection methods include interviews, observations and focus group discussions. Interviews conducted were based on interpretation of a structure questionnaire to respondents in their local languages. The questions were meant to find out the knowledge and experience of pesticide applicators (both exterminators and farmers). Specific questions were on their biography, how long they have been applying pesticides, their use of PPEs and whether they have received any form of training or not and how frequent they apply pesticides. It was also used to gather specific information from Health professionals and respondents from the Environmental Protection Agency.

Observation method was used to look at how farmers and pest exterminators apply pesticides. Observations were done on handling, mixing and applying pesticides. The observation also focused on use of appropriate pesticides, types of application equipment's used and the techniques of applying the pesticides. Five farmers and five pest exterminators were observed in the field. Focused group discussion was held for 10 farmers and 10 pest exterminators. Data was analysed using descriptive statistical tools like frequencies and percentages from.

## Results

The study result show pesticide application is dominated by males as they constitute 97% of the respondents with only 3% females. The 3% female respondents interviewed were pest exterminators and none was a farmer. Nearly half of the respondents are in their youthful ages given the 19% that are 40-44 years and another 19% that are 20-24 years of age (Figure 3). The least age category is the age group of 50-54 years whose safety is a matter of concern as they are mostly breadwinners of their families. Out of the 100 respondents 57% of them are married, 7% of them are divorced, 5% are widowed and 31% are single. The statistics provided show that about 69% of the people interviewed had dependents to feed as such need to be safe to feed their families. In terms of education, 56% of pest exterminators are highly educated as they have tertiary level qualifications and 34% are educated up to JHS/Middle school level (Table 1). As far as the farmers are concerned 60% had no education and 16% had JHS or middle school education.

Responses to questions on the religious backgrounds of chemical applicators revealed that the majority are Christians 69%, followed by Muslims 20% and 8% African Traditional Religion worshipers with the remaining 3% as people who do not belong to any religion. High level of education usually influences the extent to which people understand and apply safety precaution when using poisonous chemicals.

### Duration of exposure to pesticides

In attempt to determine the risk levels of pest exterminators and farmers, they were asked the number of years they have worked as people applying chemical with the view to understand how long they have been exposed to the chemicals. Twenty six percent (26%) of the pest exterminators said they have been applying pesticide for over 10 years and 32% have been applying pesticide for less than 2 years (Figure 4). At a focused group discussion pest

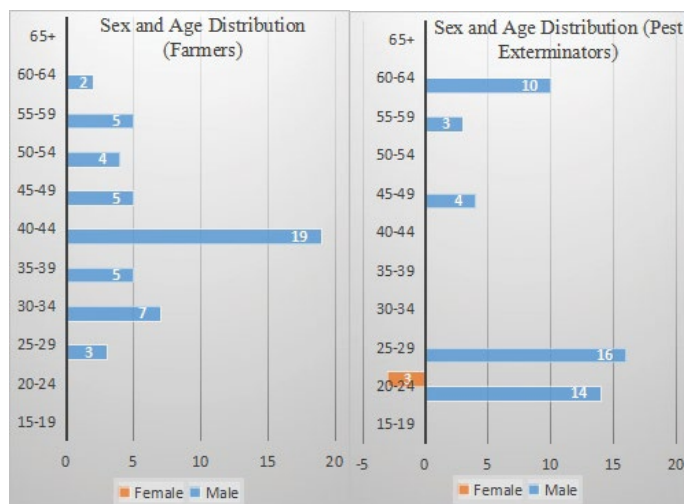


Figure 3. Age and sex distribution of respondents

Table 1. Educational background of farmers and pest exterminators. Source: Field Survey, June 2019.

Highest Level of Education	Farmers		Pest Exterminators	
	Frequency	Percentage	Frequency	Percentage
No Education	30	60%	0	0%
Pre-education	5	10%	0	0%
Primary	7	14%	0	0%
JHS/Middle	8	16%	17	34%
SHS	0	0%	5	10%
Tertiary	0	0%	28	56%
<b>Total</b>	<b>50</b>	<b>100%</b>	<b>50</b>	<b>100%</b>

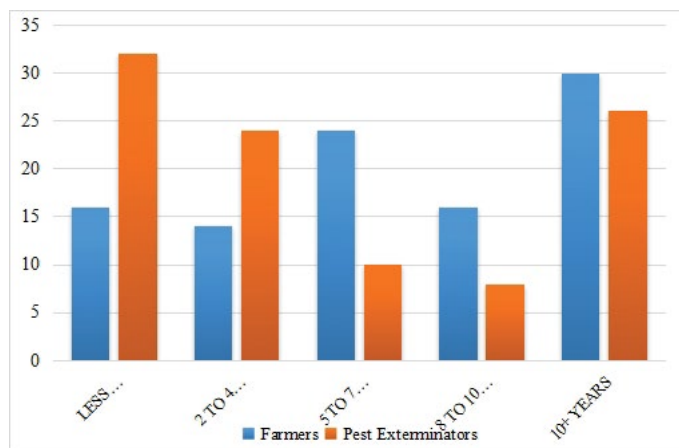


Figure 4. Years of experience in pesticide application. (Source: Field Survey, June 2019).

exterminators were asked why they choose to work as pest exterminators when they could have been employed elsewhere and whether they know the risks involved. Their responses indicate they are aware of the risks involved and are willing to stop the work when they get alternative jobs. In the case of farmers, nearly 50% of them responded they have been applying pesticides for average period of 8 years and 16% of them have applied pesticide for less than two years. Also 24% of the farmers have been applying pesticide for 5 to 7 years. At a focused group discussion farmers claimed they were born into farming where their parents are professional farmers as such are not likely to look for alternative jobs because of their passion for farming (Figure 4).

In terms of years of exposure, farmers are more exposed to the effects of the chemicals compared to professional pest exterminators who apply pesticides for few years and then look for alternative jobs. Most of the pest exterminators mentioned that the duration per treatment of an area is location

specific and also depend on the level of pest infestation. On the average 48% of the pest exterminators take about 2 hours to complete a treatment, 8% take over 5 hours to complete their pesticide application assignments and 10% use about 4 hours. The rest of the respondent 22% pest exterminators use about an hour and 12% use less than an hour to complete pesticide application assignments. As far as the farmers are concerned, 50% of them use about 1 hour per day to apply pesticides on their farms, 32% use 2 hours and the remaining 18% use less than an hour for pesticide application. This implies that pest exterminators tend to spend more hours to apply pesticides therefore are more exposed during pest treatment.

### Frequency of pesticide applications

Both farmers and pest exterminators were asked how often they apply pesticides and 84% of the pest exterminators said they apply pesticides on weekly basis while the remaining 16% said they apply pesticides on monthly basis. Most of the pest exterminators also mentioned that, Ghanaian's hardly contract pest exterminators to destroy pests in their homes except those who are plagued and get overwhelmed. On the part of farmers 68% of them apply pesticides on daily basis and 32% apply pesticides on weekly basis (Figure 5). The farmers explained that applying pesticides is not an activity that is done continuously in an entire year but during the farming season. They further explained that they mostly apply weedicide to destroy weeds. A week after applying weedicides insecticides are applied to control insects and fungicides applied to prevent or control disease infestation till harvest.

### Training on hazards associated with pesticide use

In view of the fact that poisonous pesticides are used by farmers and pest exterminators they were asked questions to assess the extent to which they have been trained to handle the chemicals they use. Responses obtained indicate that only 4% of the farmers had training in pesticide application while the majority of 96% had no training on how to mix and apply pesticides. The 4% who claimed they were trained in pesticide application said they were trained by the Ministry of Food Agriculture. As far as the pest exterminators are concerned 72% of them said they were trained and 28% had no training in mixing of chemicals and pesticide application. Training of pest exterminators were done by the Environmental Protection Agency according to 14% of the pest exterminators while 25% were trained by the School of Hygiene and 62% were trained by the Masters under whom they worked.

### Use of personal protective equipment (PPE)

When farmers were asked if they use PPE when applying chemicals, 90% of them said "yes" and 100% of the pest exterminators also said "yes". Out of the 90% farmers that use PPE, about 11% change them monthly, 47% change them yearly, 4% change them bimonthly and the remaining 38% change them when it gets spoilt. Among the pest exterminators, 32% dispose-off their PPEs immediately after use, 20% change them weekly, 30% change them monthly and the remaining 18% change them yearly (Table 2).

In Table 2, all pest exterminators (100%) use respirators as PPEs when

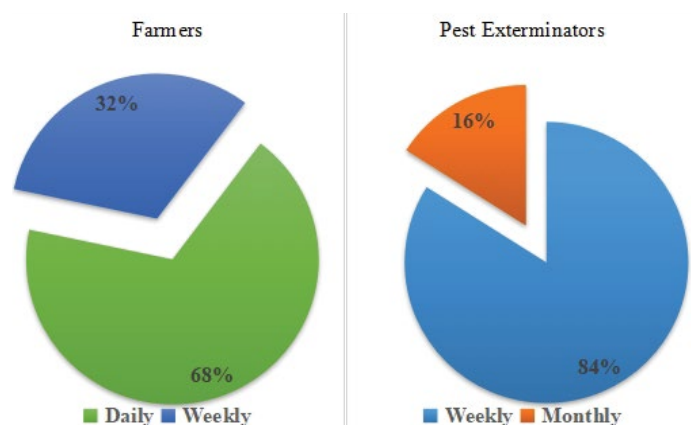


Figure 5. Frequency of pesticide applications. (Source: Field Survey, June 2019).

**Table 2.** Use of PPE by farmers and pest exterminators. Source: Field Survey, June 2019.

PPE	Farmers	Pest Exterminators
Goggle	4%	38%
Respirator	84%	100%
Noise Canceler	6%	18%
Overall	0%	78%
Gloves	40%	28%
Boot	28%	62%
Face Mask	14%	28%
Helmet/Hat	14%	18%

working and 84% of the farmers. In terms of wearing of overall/overcoat 78% of pest exterminators use it when applying pesticides but none of the farmers wear overall/overcoats. When it comes to the use of goggles and face masks few of the farmers and pest exterminators use them as such the majority are exposed to chemicals. In terms of use of noise canceler, pest exterminators who use motorized machines that generate noise thus 18% use them while only 6% of the farmers use them as the majority use manual Knapsacks (Figure 6). Figure 7A and 7B show pictures of two respondents observed while applying pesticides. As seen in the pictures, the farmer wears only a hat and a goggle while the pest exterminator is in full PPE but had no gloves and goggles (Figure 6).

### Disposal of empty pesticide containers and surplus pesticide mixtures

Wrong disposal of used pesticide containers is seen as a health hazard to neighbouring households as such respondents were quizzed to assess how they dispose-off their containers. The majority of pest exterminators (43%) burn the empty pesticide containers while 38% throw them away in open spaces or put them into waste bins for disposal and 19% keep them in their store rooms. Majority of the farmers 77% burn the empty containers. The act of burning such containers contributes to the release of dangerous toxins into the atmosphere which can be inhaled by those in the neighbourhood. Field observation showed most of the empty pesticide containers were scattered on farms.

### Disposal of surplus pesticide mixtures (SPM)

The excess pesticide left after treatment are poured into drains according to 80% of the pest exterminators while others give the surplus to neighbours who later use them to spray their neighbourhoods to prevent pest infestation. In the case of the farmers leftover mixtures are used to re-spray crops (34%), spray other farms (26%), throw them away on bare lands (20%), keep the remaining pesticide mixtures in the spraying machines and re-use them next day (8%). The remaining 12% of the farmers said they carefully measure and mix the chemicals such that there are no leftovers. There were however instances where 18% of the farmers keep the remaining pesticides in their homes a practice that is risky to the health of the farmer and the entire household especially to children.

### Other hazardous practices

Some hazardous practices engaged in by farmers and pest exterminators is eating and drinking while spraying. For instance, 64% of the farmers said they eat when applying pesticides and 84% said they drink when spraying. They explained that their work is tiring for that matter make them exhausted as such they had to drink water from sachets that they think are safe forgetting it is very easy to ingest pesticides when spraying and this can have dreadful impact on their health.

In the case of pest exterminators, none of them drink water and eat while applying pesticides. When asked why they don't drink and eat when applying pesticides they said it is risky to do so hence their field supervisors and "masters" made sure they always eat or drink water only before or after pesticide application when hands are thoroughly washed. The high sense of alertness on the part of pest exterminators compared to the farmers may be as a result of the higher level of education they have compared to the farmers

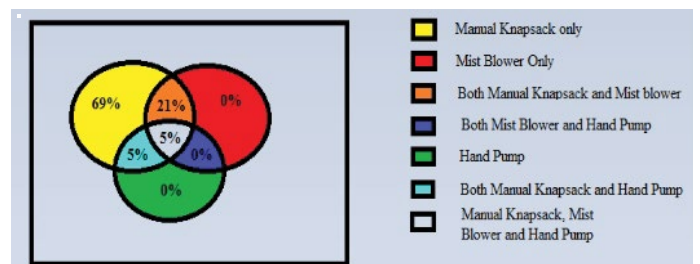
who are less educated. Another dimension to the differences in attitude could be that almost 100% of the farmers rely on the advice of retailers who sell the chemicals to them and advise them on how to use them which may not be accurate unlike the pest exterminators who get advice from consultancy agencies who are professionals. When a personal audit was done in some retail shops in Accra it was found that only few of them were certified to sell pesticides while the majority are in the business to earn a living without the requisite knowledge on the types and nature of pesticides they sell. These inexperienced pesticide/ weedicide sellers poses great danger to farmers as they can easily mislead them given that only 34% of the farmers interviewed could read labels on pesticide containers.

### Conditions that increase the level of pesticide exposure to applicators

Even though farmers and pest exterminators apply a lot of pesticides they operate under different conditions as such as are exposed differently to the risk factors of pesticides. In case of farmers they apply pesticides outdoors which means that though farmers get exposed to pesticides the ventilation during application of pesticides reduce the intensity of exposure. Even in this situation of reduced risk of exposure, risk levels can be high when accidents due to wind movement towards the sprayer occurs leading to massive inhalation of pesticides as reported by (50%) of the farmers. Accidental spillage was reported by 13.9% of respondents and use of faulty spraying equipment was mentioned by 16.7% of the farmers as a cause of accidents. Failure of personal protective equipment was mentioned by 19.4% of the farmers. In the case of pest exterminators who work indoors such as people's residence, hotels, hospitals and offices they get more exposed to chemical poisoning when not wearing the necessary personal protectives in poorly ventilated areas where pesticides are concentrated. A little over half of the pest exterminators (53%) complained about intense exposure to chemicals when the PPE they use failed them.

### Revisit to site after pesticide application

When asked how often respondents revisit treated sites after the initial pesticide application, most of the pest exterminators (72%) said they rarely

**Figure 6.** Respondents and equipment's used for pesticide application. (Source: Field Survey, June 2019).**Figure 7.** Two respondents applying pesticide (A and B).

revisit sites after treatment and that they only communicate with their clients via phone to do follow up on the treatment, few of them (8%) said they revisit monthly while the remaining (20%) said, they do regular pest control exercises for most of their clients so they usually revisit quarterly to repeat the treatment (Table 3). The farmers on the other hand said they work daily on farms and by the nature of their work it can be deduced that farmers are more exposed to pesticides while pest exterminators are less exposed given that farmers spend almost the whole day on their farms.

### Potential health hazards faced by pesticide applicators

When respondents were asked if they feel any symptoms attributed to pesticide application, they mentioned dizziness, red itchy eyes, excessive sweating, skin rashes, burning sensation of the skin, coughs, running nose, wheezing, general body weakness and heavy breathing. Most of the farmers did not seem to worry so much about health symptoms because they considered them as 'occupational hazards' while others believed that these symptoms were 'slight illnesses'.

## Discussion

Application of pesticides on farms and elimination of pests at homes is a male dominated activity done by people who are 50-54 years and mostly bread winners for families. In terms of education, pest exterminators have higher levels of education compared to farmers who apply chemicals. The high level of education on the part of pest exterminators seem to have enabled them to adhere to safety precautions for their own well-being. In the case of farmers, less attention is paid to safety precautions which is considered a risk to their health. A study among watermelon farmers in the central region of Ghana showed farmers experienced symptoms of headache, burning sensation, fever, watering eyes and chest pains after spraying agro-chemicals [18].

Disposal of empty chemical containers is an issue of concern given the poor manner in which the majority of respondents (43%) burn the containers openly and (38%) throw them away into open spaces where children and adults pick them up for re-use. The few (19%) who keep them in their store rooms such as the pest exterminators need to be commended for their safety practices. Similar studies in Ethiopia show that majority of farmers do not handle containers of chemicals they spray properly as in the study area [19]. In view of health dangers associated with use of dangerous chemicals it has been advised that handlers of chemicals that are heavily contaminated and undiluted must discard them immediately after use so that they are not accessible to anyone for reuse [20].

Application of pesticides predispose farmers and pest exterminators to inhaling chemicals which damage their skin when the chemicals touch their body in course of their work especially when working for long hours. In this regard farmers who spray weekly or bi weekly are believed to be at greater risk of associated health consequences but may not be severely affected when necessary precautions are taken at work. It is necessary that the low capacity of only 28% pest exterminators being well trained and the numerous farmers having no training should be addressed. Previous studies show similar low number of trained pest applicators in Ghana [21].

Damalas & Eleftherohorinos, (2011), argued that the high degree of toxic substances in chemicals kill and harm organism as such optimal caution is

**Table 3.** Respondents and how often they re-visit the treatment sites. Source: Field Survey, June 2019.

Duration	Farmers			Exterminators	
	Total freq.	Freq.	%	Freq.	%
Never	0	0	0	0	0
Always	50	50	100	0	0
Monthly	4	0	0	4	4
Rarely	36	0	0	36	36
Quarterly	10	0	0	10	20
<b>Total</b>	<b>100</b>	<b>50</b>	<b>100</b>	<b>50</b>	<b>100</b>

required to prevent accidental spillage and leakages of chemicals coupled with the use of faulty spraying equipment. In an effort to ensure strict adherence to safety precautions the US puts the minimum age for applying chemicals at 18 years hoping at this age the risk factors will be well understood [22]. Effects of such hazardous chemicals on affected people occur as short-term skin and eye irritation, headaches, dizziness, and nausea to chronic effects of cancer, asthma, and diabetes where the risks are difficult to treat due to long periods of exposure and type of pesticide used in terms of level of toxicity and the environmental characteristics of affected areas [23].

## Conclusion

The application of chemicals either on farms or homes can be risky when the appropriate precautions are not taken seriously. The longer a person is exposed to pesticides and weedicides in poorly ventilated environments the more serious the potential health risks.

## References

- Kumari, P. Lavanya and Giridhar K. Reddy. "Knowledge and practices of safety use of pesticides among farm workers." *J Agr Veter Sci* 6 (2013): 1-8.
- Kibria, Golam. "Pesticides and its impact on environment, biodiversity and human health-A short review." *Proj Rech* 1 (2016): 1-6.
- Lobin, K. K., Jaunky V. C. and Ramesh V. "A review of pesticide use in EU and African countries and associated policies in Proceedings of 120<sup>th</sup> The IIER International Conference (2017)." Port Louis, Mauritius (2017).
- Akashe, Megha M., Uday V. Pawade and Ashwin V. Nikam. "Classification of pesticides: A review." *Int J Res Ayurveda Pharm* 9 (2018).
- Food and Agriculture Organization & World Health Organization "The international code of conduct on pesticide management." (2016).
- Damalas, Christos A. and Ilias G. Eleftherohorinos. "Pesticide exposure, safety issues, and risk assessment indicators." *Int J Environ Res Public Health* 8 (2011): 1402-1419.
- AGRA. "Africa Agriculture Status Report: The business of smallholder agriculture in Sub-Saharan Africa." *Alliance for a Green Revolution in Africa*, Nairobi, Kenya 5 (2017).
- Onwona Kwakye, Michael, Belay Mengistie, John Ofofu-Anim and Alexander Tetteh K. Nuer, et al. "Pesticide registration, distribution and use practices in Ghana." *Environ Dev Sustain* 21 (2019): 2667-2691.
- Ahiabor G. "Danger on farms: Health dilemma of pesticide use in modern agriculture." (2015).
- Kumar, Naveen, Ashok K. Pathera, Parveen Saini and Manish Kumar. "Harmful effects of pesticides on human health." *Ann Agri Bio Res* 17 (2012): 125-127.
- Fianko, Joseph R., Augustine Donkor, Samuel T. Lowor and Philip O. Yeboah. "Agrochemicals and the Ghanaian environment, a review." *J Environ Prot* 2 (2011): 221.
- Ntow, William J., Huub J. Gijzen, Peter Kelderman and Pay Drechsel. "Farmer perceptions and pesticide use practices in vegetable production in Ghana." *Pest Manag Sci: Formerly Pest Sci* 62 (2006): 356-365.
- Afari-Sefa, Victor, Elvis Asare-Bediako, Lawrence Kenyon and John A. Micah. "Pesticide use practices and perceptions of vegetable farmers in the cocoa belts of the Ashanti and Western Regions of Ghana." *Adv Crop Sci Technol* 3(2015).
- Accra Metropolitan Assembly. "The composite budget of the Accra Metropolitan Assembly for the 2016 fiscal year." (2016).
- Osei, Simon K., Benjamin Y. Folitse, Lucy P. Dzandu and Grace Obeng-Koranteng. "Sources of information for urban vegetable farmers in Accra, Ghana." *Inf Dev* 33 (2017): 72-79.
- Martin, Matthew T. "Classification of chemicals based on structured toxicity information." PhD diss., The University of North Carolina at Chapel Hill. (2008).
- Lanphear, Bruce P. "Low-level toxicity of chemicals: No acceptable levels?." *PLoS Biol* 15 (2017): e2003066.

18. Miyittah, Michael K., Moses Kwadzo, Abigail Peprah Gyamfua and Daniel E. Dodor. "Health risk factors associated with pesticide use by watermelon farmers in Central region, Ghana." *Environ Syst Res* 9 (2020): 1-13
19. Mesfin, Knife. "Assessment of the status of obsolete pesticide stocks in selected parts of Ethiopia Knife." *Int J Environ Sci Nat Resour* 7 (2017): 32-37.
20. United States Environmental Protection Agency. "Pesticide Worker safety, personal protective equipment for pesticide handlers." (2020).
21. Wisconsin Farm Bureau Federation. "DATCP clarifies age requirements for pesticide use." (2017).
22. Kim, Ki-Hyun, Ehsanul Kabir and Shamin Ara Jahan. "Exposure to pesticides and the associated human health effects." *Sci Total Environ* 575 (2017): 525-535.
23. EPA Ghana. "National profile to assess the chemicals management infrastructure in Ghana." (1997).

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