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Pesticide use and health risk awareness of okra (*Abelmoschus esculentus* L.) farmers in Dalun in Kumbungu District, Ghana

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ABSTRACT

Pesticides are extensively used to control pest infestation by most vegetable farmers, who often have little knowledge or no regard for the safety precautions on their usage. This research investigated pesticides use and health risk awareness of okra farmers in Dalun in the Kumbungu District, Northern Region of Ghana. Cross-sectional research study was used. A total of 50 farmers were purposively sampled for a face-to-face interview. The results showed that all the respondents use pesticides. However, 92% of the respondents always use pesticides in cultivating okra whilst 8% only use the pesticides when they have money to buy them. The study revealed that 76% of the respondents apply pesticides 4 times or more in a single growing season depending on the level of pest infestation. The study also found that 78% of the respondents do not use any protective clothing during pesticides application. All the respondents do not have access to extension services and manuals on the use of the pesticides they apply. Moreover, 80% of the respondents opined that a relationship exists between pesticides usage and health risk. To mitigate the toxic effects of pesticides upon accidental ingestion, most farmers (92%) drink milk which they believe can neutralise the adverse health effects. The farmers use a lot of pesticides in their crop production with low literacy level on proper handling and usage of the pesticides. It is therefore recommended that government should support these farmers with protective clothing and extension training on safe handling and usage of synthetic pesticides.

Key words: Farmers, Health literacy, Health risk, Pesticides, Okra

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INTRODUCTION

Okra (*Abelmoschus esculentus* L) commonly referred to as lady's finger, Gombo (French), Miyan-gro, (Hausa) and Mana (Dagbani), is a commercial traditional vegetable crop cultivated in the tropical and subtropical regions including Africa, Asia, America and the Southern European and Mediterranean countries (Ghodia *et al.*, 2015). Ghana produces over 100,000 metric tonnes of okra annually with India being the largest producer globally (Tridge, 2020). Okra is cultivated in the Northern regions of Ghana owing to its ability to withstand drought, high commercial and nutritional value, as such it is a major component of traditional cuisines in the Northern regions (Besirli *et al.*, 2018). In recent years, biotic and abiotic stresses such as climate change, pests and disease infestation have affected okra production in the Northern region thus compelling farmers to combine dry season irrigation, fertiliser and pesticides application in order to improve yield.

Okra, though a robust and resilient vegetable crop, is susceptible to a myriad of insect pests and disease pathogens attack including shoot and fruit borer, leafhopper, whitefly, red spider mites, solenopsis mealy bug, root-knot nematodes, fusarium wilt, powdery mildew, damping-off and bacterial blight (Ibok, 2019; Kedar *et al.*, 2014). In response, farmers resort to the use of pesticides to control and manage pests and disease infestation. However, improper pesticides use behaviour and poor health literacy has been reported amongst farmers thus posing a significant threat to food security, health and safety of farmers and the general public (Kenko *et al.*, 2017).

The rate of pesticides poisoning in 2004 was estimated to be about 3 million cases with 250,000 deaths or fatalities per annum (WHO, 2004). It is estimated that pesticides poisoning affects 2 - 3 persons per minute globally (Macharia, 2015). The short term and long-term health effects of exposure to pesticides include headaches, respiratory problems, cancer, asthma, dermatitis, endocrine disruption, reproductive dysfunctions, immunotoxicity, neurobehavioral disorders, and birth defects (Kim *et al.*, 2017; Macharia, 2015). This results in expenditure on health care by farmers, low productivity and food insecurity.

In many developing countries, the use of personal protective equipment (PPEs), handling and storage of pesticides, as well as the disposal of pesticides containers is frequently abused by most

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poor resource farmers. Illiteracy, cost, non-availability of PPEs, discomfort and customs are often cited as reasons for non-compliance to health and safety protocols (Mattah *et al.*, 2015; Macharia, 2015). Exposure of farmers to toxic pesticides can be significantly reduced when health and safety measures are strictly observed (Joko *et al.*, 2020). Health literacy and education amongst farmers is very crucial in reducing the risks of handling synthetic pesticides (Van Hoa *et al.*, 2020). In Ghana, the extension officer to farmer ratio is estimated to range between 1:1300 and 1:1500 (Yussif, 2019). In the Northern region, the ratio is 1:2300 which is far lower than the national average and the Food and Agriculture Organisation's standards (Yussif, 2019). This research was aimed at ascertaining the pesticides use and level of health risk awareness of okra farmers in Dalun and the indigenous health risks mitigation strategies applied. The extensive application of chemical pesticides is a major concern for farmers' and consumers' safety and health, food security and ecological safety.

MATERIALS AND METHODS

Study area

The study was conducted in Dalun, a farming community in the Kumbungu District of the Northern Region of Ghana. The district shares boundaries to the North with Mamprugu/Moagduri District, Tolon and North Gonja Districts to the West, Sagnerigu District to the South and Savelugu-Nanton Municipality to the East. The population of the district as at 2010 is 39,341 with 19,686 males and 19,655 females (Ghanadistricts, 2020).

Figure 1. A map showing the study location (Adapted from Kuivanen *et al.*, 2016)

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Study design, sampling technique and sample size

The research was conducted from March to May, 2020 using cross sectional study. A total of 50 okra farmers at the study area were purposively sampled and a face-to-face interview conducted using an unstructured interview guide. Fifty (50) respondents were sampled on the basis of data / theoretical saturation. This theory suggests that during the process of data collection, if no new information or additional data is obtained, then it is necessary to stop data collection (Saunders *et al.*, 2018). Similarly, questionnaires were completed by the respondents with the assistance of enumerators. These were done based on the availability and willingness of farmers to partake in the study.

Data Collection

Primary data were obtained using questionnaires and face-to-face interviews. Field reconnaissance surveys were conducted to understand the scope of okra production, build rapport with farmers and also quantify the logistics and resources needed for the data collection.

A questionnaire was developed and pretested using interview guide. The questionnaire contained both structured and unstructured questions under socio-economic demographics, pesticides use behaviours and health literacy on pesticides use amongst the study population. Unstructured interviews were conducted to elicit information from the farmers on the perceived barriers and solutions to health literacy on pesticides use and the adopted indigenous health risks mitigation and adaptation strategies applied.

Data Analysis

Data were analysed using SPSS version 26 and Microsoft office excel. These were used to process the quantitative data into graphs, charts, and tables for interpretation and discussion. Correlation and chi-square analyses were also conducted to identify any significant statistical relationship among the study variables.

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RESULTS AND DISCUSSION

Socio-demographic characteristics of respondents

The study revealed that, all the respondents were males and majority aged between 26 - 35 years. Majority of the farmers (68%) had no formal education (Table 1). A similar research reported that about 75% of the respondents were in their youthful age and about 67% had no formal education (Imoro *et al.*, 2019). In sub-Saharan Africa, about 65% of the agricultural activities are manually done (DFID, 2014). This could probably be the reason for majority of the okra farmers in the study area being youth, since they possess the needed physical strength for this job. Moreover, the inability of the farmers to read and understand the English instructions on pesticide labels could contribute to their poor attitude in handling the pesticides.

Table 1: Demographic characteristics of respondents

Age of respondent	Frequency (N = 50)	Percent (%)
16-25 years	15	30
26-35 years	28	56
36-45 years	7	14
Total	50	100
Gender of respondent		
Male	50	100
Total	50	100
Level of education		
No formal education	34	68
Primary	13	26
JHS/SHS	2	4
Tertiary	1	2
Total	50	100
Religion		
Islam	50	100
Total	50	100
Marital status		
Married	47	94
Divorced	3	6
Total	50	100

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Socio-economic characteristics

Majority of the respondents (58%) make an average monthly income of GH¢ 1.00 to GH¢500.00 whilst 2% obtain a monthly income of GH¢ 1501.00 to GH¢ 2000.00 (Table 2). In addition, majority (78%) of the farmers had at least 5-year experience in okra farming (Table 2). In terms of farm sizes, 42% of the respondents cultivate about 1 acre (0.40 ha) and about 58% cultivate about 0.50 acres (0.20 ha). Majority (96%) of the farmlands are customary lands and are thus leased to farmers for farming purposes. The study revealed that only 40% of the respondents owned the farmlands they utilise whilst 60% rent the lands or are squatters. The study further revealed that 72% of the respondents rely on their own labour (Table 2). It was also found that 34% of the respondents work on other people's farms for some income.

Table 2: Socio-economic characteristics of the farmers

Average monthly income of respondent (GHS)	Frequency	Percent (%)
1 -500	2	4
501 – 1000	18	26
1001 – 1500	29	58
1501 – 2000	1	2
Total	50	100
How long have you been farming		
Less than 5 years	4	8
5-10 years	32	64
10-15 years	7	14
15 years and above	7	14
Total	50	100
What is your farm size		
½ acre	29	58
1 acre	21	42
Total	50	100
Type of Labour		
Self	36	72
Family labour	6	12
Self and family labour	1	2
Self and hired labour	6	12
Self, family labour and hired labour	1	2
Total	50	100
Are you a migrant or a permanent resident/native		
Native	50	100

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Pesticides use behaviours

The study established that all the respondents use chemical pesticides on their farms with majority of the respondents (92%) using it every growing season. Ninety-two (92%) of the respondents apply the pesticides by themselves whilst 4% engages the services of other people. On the frequency of pesticides application, it was revealed that majority (76%) of the farmers apply synthetic pesticides 4 times or more in a growing season and 24% apply the pesticides 2 - 3 times in a growing season (Table 3). These findings have indicated wide spread and extensive use of synthetic pesticides. Thus, raising serious concerns about the health implications on farmers and consumers of the produce. Further interviews with the farmers revealed that, the frequency of pesticides application is generally dependent on the levels of pest infestation, thus the higher the infestation, the more pesticides are applied. This finding was in line with previous findings (Joko *et al.*, 2020). Insect pests infestation, of okra can cause up to 50% decrease in fruit yield (Kanwar and Ameta, 2007). This may therefore be an underlining factor for the observed frequency in pesticides application. This finding is consistent with research by Mattah *et al.* (2015), who reported that about 57% of farmers apply pesticides 3 - 4 times or more depending on the level of pest infestation.

The study showed that the respondents are mainly smallholder vegetable farmers with farm sizes less than 1 hectare and this could therefore explain their ability to easily afford adequate quantities of the pesticides the use. Damayanti *et al.* (2019) observed that, the higher the spraying frequency amongst farmers the higher their leukocytes levels. Thus, the increased levels of leukocytes is an indication of exposure to toxicity or immune system disorders (Damayanti *et al.*, 2019). Similarly, there is a risk of exposure of consumers to pesticides residues as a result of the excessive application of pesticides. This therefore raises public health and food safety concerns (Adekalu *et al.*, 2020). The study revealed that 78% of the farmers do not use any proper protective clothing (overalls, boots, nose mask, hand gloves etc) whilst only 22% use some protective clothing (Table 3). This finding is similar to previous reports that indicated that most farmers in developing countries do not use recommended PPEs during pesticide application (Joko *et al.*, 2020; Malambo *et al.*, 2019; Imoro *et al.*,2019; Mattah *et al.*, 2015; Macharia,2015). The few farmers who use PPEs either use only nose coverings, long sleeve clothing and sometimes goggles which do not usually provide adequate protection to the farmers.

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Unavailability of PPEs and unaffordability were two of the major challenges that accounted for the low usage of PPEs. The respondents stated that most of the agrochemical shops in the District do not sell PPEs and as such they had to travel to the regional capital (Tamale) in order to purchase them which comes at an extra cost and is usually expensive. On handling empty pesticides containers after use, 44% of the farmers burn them on the farm whilst 36% drop the containers on the farm indiscriminately (Table 3). The observed method of disposal is similar to the findings of Manfo *et al.* (2020) who conducted their research in Cameroon. In the Tolon District of Ghana, 64% of farmers dispose of pesticide containers indiscriminately, 20% burn the containers, 13% bury it in the soil and 3% use the containers to store seeds (Imoro *et al.*, 2019). In contrasts, the reuse of pesticides containers was the major disposal method recorded by Hinson *et al.* (2015) in Benin and Malambo *et al.* (2019) in Zambia. Malambo *et al.* (2019) reported that 59% of the respondents reuse pesticides containers of which about 81% reuse the containers to store drinking water and salt.

Table 3: Pesticides use of farmers

Do you apply the pesticides by yourself	Frequency (N = 50)	Percent (%)
Yes	46	92
No	4	8
Total	50	100
How often do you apply pesticides in a growing season		
2-3 times	12	24
4 times and above	38	76
Total	50	100
Stage of pesticide application		
Pre-emergence	1	2
Post emergence	49	98
Total	50	100
Do you use protective clothing when applying pesticides		
Yes	11	22
No	39	78
Total	50	100
If yes, please check one or more of the following		
Gloves	1	9.1
Overalls	1	9.1
Boots / Shoes	3	27.3
Nose Masks, Boots/ Shoes	4	36.4

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Overall and Boots/shoes	2	18.1
Total	11	100
If no please indicate why		
Too expensive	7	18
Not available	32	82
Total	39	100
What do you do with empty pesticides containers after use?		
Leave them on the farm	18	36
Burn them	22	44
Bury them	9	18
Other	1	2
Total	50	100

Pesticides types

The study revealed that insecticides and herbicides were the common types of pesticides used by all the respondents (Table 4). This is consistent with the report that insecticides are one of the common synthetic chemicals imported into Ghana (Fianko *et al.*, 2011). Again, Hinson *et al.* (2015) and Mattah *et al.* (2015) reported that insecticides and herbicides were among the most common agrochemicals used in Ghana. The common pesticides found with the farmers interviewed are shown in Table 4. Three out of 6 of the pesticides have been classified as moderately hazardous, two as slightly hazardous whiles only one is unlikely to cause harm when properly applied.

Table 4: Pesticides types

Brand Name	Active Ingredient	Type of Pesticide	Frequency	Percent (%)	WHO Classification
K-optimal	Lambda Cyhalothrin + Acetamiprid	Insecticides	50	100	II
Butachlor	Butachlor	Herbicides	2	4	II
Lambda	Lambda Cyhalothrin	Insecticides	2	4	II
Condemn	Glyphosate	Herbicides	1	2	III
Agil	Propaquizafop	Herbicides	1	2	U
Golan	Acetamiprid	Herbicides	1	2	III

Note: II =Moderately hazardous; III = slightly hazardous; U = Unlikely to present acute hazard in normal use (WHO, 2020)

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Health risk awareness of pesticide use

The study revealed that all the respondents (100%) have no access extension services and do not receive manuals and/or audio-visuals on the proper use and handling of pesticides. About 74% of the farmers were aware that improper use of pesticides may result in health implications. Similarly, 80% of the respondents think that there is a relationship between their pesticides use behaviours and their health. The observed awareness of farmers about the threat of improper use of pesticides poses to their health may be due to their personal experiences, information from agrochemical sellers and colleague farmers (Imoro *et al.*, 2019; Mattah *et al.*, 2015). Access to agricultural extension services is very important in improving pesticides use and handling practices amongst farmers. A research conducted by Hinson *et al.* (2015) found that farmers who had access to extension services and training could handle pesticides better. Malambo *et al.* (2019) reported that increasing access to training and extension services on the proper handling of pesticides could increase the safe use of pesticides by up to 25%.

In the developed countries, pesticides use is more common yet the incidence of pesticides poisoning is rare due to proper handling practices whilst the reverse occur in developing countries. This can be attributed to poor health awareness in developing countries as compared to developed countries (Jørs *et al.*, 2018).

Health literacy is a measure of the degree to which basic health information and services are made readily accessible for individuals to obtain, process, understand and make meaningful health decisions (Van Hoa *et al.*, 2020). Extension officers help disseminate research-based knowledge to farmers on the best agricultural practices. The observed poor pesticides handling practices can be improved if the ratio of extension officers to farmers is improved. The extension officers to farmer ratio in the Northern region of Ghana is very poor and stands at 1:2300 (Yussif, 2019; Buehren *et al.*, 2019). The study did not show any statistically significant relationship between the level of education of farmers, health literacy and the observed pesticides use behaviour. This notwithstanding, research by Vamos and Yeung (2017) has shown that there is a strong relationship between level of education and health literacy. Thus, education is more likely to positively influence health literacy which will in turn improve health outcomes. The Shanghai declaration on health promotion in 2016 recognises the importance of health literacy in achieving

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the sustainable development goals by improving public health and eradicating poverty (WHO, 2017).

On health risks mitigation measures adopted by the farmers, 92% of the respondents drink milk when they accidentally ingest pesticides (Table 5). Milk is considered a diluent and adsorbent that helps to reduce the concentration and toxic effects of some ingested poisons. However, it is recommended that drinking milk should only be taken as a first aid intervention and is not applicable to all types of pesticides or toxic compounds (USEPA, 2019; Ogg *et al.*, 2018). Most farmers considered drinking milk as an absolute remedy for oral exposure to pesticides. Moreover, about 84% of the respondents bath and/or wash their body with water after dermal exposure to pesticides (Table 5). This practice though recommended by researchers as a first aid measure is used as an alternative to visiting the hospital or seeking the help of a physician. Majority of the respondents bath or wash their eyes with water when pesticides accidentally enter the eyes (Table 5). It was noted that 16% apply Kohl, 12% do nothing, 2% use eye drops, 2% drink milk and 2% wash and apply Kohl (Table 5). The use of water to wash the eyes is a recommended first aid practice intended to reduce the concentration and reduce the effect of the pesticides on the eyes. However, applying eye drops without prescription as was observed can pose a significant health threat (USEPA, 2019).

The use of Kohl as an indigenous method of reducing and/or remedying the harmful effects of pesticides (Table 5) poses a threat to the health of farmers. Kohl or Surma which is popularly referred to as "Chilo" in the Dagbani dialect is a traditional eye cosmetic (eyeliner) often used in the Middle East, India, Pakistan, and some parts of Africa. Kohl has been shown to contain high levels of lead and is often associated with lead poisoning (Filella *et al.*, 2020). There is currently no available research or study that proposes that Kohl can be used as a remedy and/or treatment to pesticides exposure. However, some researches have shown that Kohl can be beneficial to humans by reflecting UV radiation away from the human eye. It is mostly used as a natural health product for general eye health, treatments of cuts, and is regarded as a general antibacterial substance (Al-Akily *et al.*, 2019). Similarly, there are underlining religious beliefs for the use of Kohl, particularly in Islam where it is considered a common practice by the Holy Prophet of Islam (Ullah *et al.*, 2010; Habibullah, 2006).

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Table 5: Health literacy of farmers

What do you do / is supposed to do when you accidentally ingest pesticides?	Frequency (N = 50)	Percent (%)
Do nothing	3	6
Drink milk	46	92
Drink milk and chew groundnut	1	2
Total	50	100
What do you do / is supposed to do when the pesticides touch your skin		
Apply shea butter	1	2
Bath	42	84
Do nothing	4	8
Wash with water	3	6
Total	50	100
What do you do, when pesticides get in contact with your eye(s)		
Apply Kohl	8	16
Do nothing	6	12
Drink milk	1	2
Use eye drops	1	2
Wash and apply Kohl	1	2
Wash with water	33	66
Total	50	100

CONCLUSION

Pesticides are heavily used by farmers for the control of pest infestation and weeds. Majority of the farmers do not use any protective clothing during the application of pesticides exposing themselves to the risk of contamination and pesticides poisoning. Pesticides containers are disposed of indiscriminately after use. The use of emergency/ first aid risks reduction measures as alternatives to seeking medical care is a major concern. Kohl which is used as a health risk mitigating method may pose a significant health threat. Lack of extension services, financial constraints and low level of formal education are major reasons behind the poor attitude of farmers towards proper handling and use of synthetic pesticides. To address the problem of unsafe use of synthetic pesticides in the study area, (1) Government and Non-Governmental Organisations should support the farmers with PPEs. (2) Government, through the Ministry of Food and Agriculture, should train and educate the farmers on the safer handling and use of pesticides. (3)

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By-laws regarding the proper disposal of pesticide containers should be strictly enforced by the District Assemblies.

CONFLICT OF INTEREST

The authors of this research article have no conflict of interest.

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