

Insecticide Application in Vegetable Production and the Risk of Food Poisoning in Nkoranza Municipality, Ghana

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ABSTRACT

The application of insecticides in vegetable production has become an issue of global concern following reports of food poisoning in some countries, including Ghana. The main objective of the study was to determine incidence of insecticide-related food poisoning in vegetable production in the Nkoranza Municipality in the Brong Ahafo region. The study involved a total of 120 respondents, consisting of 40 each of producers, consumers and food vendors/vegetable traders. The commonest chemicals used in controlling insects in the study area were Confidor 2500SL [Imidacloprid (2500g soluble liquid)], Karate 2.5 [Lambda-cyhalothrin (25g emulsifiable concentrate)], Karate 5.0 [Lambda-cyhalothrin(50g emulsifiable concentrate)], Rambo 2.5EC [Deltamethrin (25g emulsifiable concentrate)] and Pawa [Lambda-cyhalothrin]. The period for the last spraying before harvesting the vegetables for the majority of the farmers was 30 minutes to 4 hours. Salt solution and water were the main solutions used in treating vegetables. However, only 7.5% of the consumers reported of illness after eating vegetables. This was confirmed by the health officials. Recommendations by vegetable farmers included: education (43.6%); use of organic insecticide (30.8%); follow instructions (20.5%); and education and follow instructions (5.2%). While the consumers suggested Treatment (54.4%); Education (34.6%); and buying from a hygienic source (9.8%). Given the level of insecticide misapplication in the study area, it is important that education on pesticide usage and regular monitoring is conducted to ensure conformance to recommended application regimes.

Keywords: Food poisoning, Insecticide application, Nkoranza Municipality, Vegetables

INTRODUCTION

The Indian Council of Agricultural Research (ICAR) (2006) observed that damage by crop pests such as insects, diseases, nematodes and rodents was one of the major constraints to increased food production. The organisation further reported that about 18% of crop losses were caused by insects, pests and diseases. Thus, the use of pesticides in controlling insects, pests and weeds had contributed significantly to increased crop yields (Dankyi, 2004). However, the over-use and abuse of pesticides had led to global pollution with its related human health problems (ICAR, 2006; Dankyi 2004).

Williamson (2001) reported a joint statement by the FAO and WHO to the effect that about 30 percent of pesticides marketed in developing countries with an estimated market value of US \$ 900 million annually did not meet internationally accepted quality standards and were posing serious threats to human health and the

environment. The application of insecticides in vegetable production has become an issue of global concern following reports of food poisoning in some countries. For instance, WHO in collaboration with UNEP (1990) reported that there were three million pesticide-related food poisoning cases in the world with about 220,000 deaths mostly in developing countries. Weir and Shapiro, (1981) also reported that at least there was 1 death/minute of chemical related food poisoning in Africa. Dankyi (2004) observed that since the year 2000, there has been a significant increase in the application of pesticides in Ghanaian agriculture. For instance, Ghana EPA (2008) reported that between 2002 and 2006 pesticide importation into the country increased from 7,763 metric tons to 27,886 metric tons with over 141 different types of pesticide products registered. NPA (2012) laments that despite the harmful effects of pesticide-use, government authorities are not doing much, in terms of measuring and documenting the extent of pesticide use and the impact on human health and the environment (NPA, 2012). However, in terms, of academic studies to determine the effects of pesticide use on farmers as well as the long-term effects on food and water intake, a number of studies have been done in Ghana. In order to appreciate the effects of pesticide use in Ghana, we outline some of these studies which are summarized in NPA (2012) as follows:

Horna *et al.* (2008) did a study of pesticide use by vegetable farmers in Southern and Central regions of Ghana and found the following: 69% of them had experienced burning sensations on the skin; 47% had experienced headaches after application of pesticides; 39% reported itchy eyes or watery eyes and had experienced both dizziness and breathing difficulties. Only 28% however, had sought medical attention at least once.

Also, Ntow *et al.* (2006) found the presence of organochlorine pesticide residues, including DDT, in the breast milk and human blood of vegetable farmers in Ghana. Some women farmers had accumulated levels of pesticide residues in breast milk above the 'tolerable daily intake' specification, beyond which their children are at risk.

Furthermore, Bempa and Donkor (2010) did a monitoring study of pesticide residues from organochlorines such as aldrin, endosulphin, endrin and DDT in fruits at 5 markets in Accra for almost a year. They found that 23.8% of the fruit samples contained residues of the insecticides above the accepted Maximum Residue Limit (MRL) while 48.7% were below the MRL. In Essuman *et al.* (2008), the study found pesticide residues in tomatoes, especially of Chlorpyrifos (dursban) and endosulfa. The risk assessment showed cancer risks for adults and children due to the presence of endulfan and chlorpyrifos. Lastly, Amoah *et al* (2008) studied sampled lettuce on sale in nine major markets and 12 specialized selling points in Accra, Kumasi and Tamale. Chlorpyrifos (dursban) was detected on 78% of lettuce, lindane on 31%, endosulfun on 36%, Karate on 11% and DDT on 33%. Amoah *et al.* (2008) stressed that most of these residues exceeded the maximum residue limit for consumption.

In Ghana, like the world over, the precise number of deaths from pesticide poisoning is not known; we only hear of reported cases of deaths and hospitalization mostly in the media (NPA, 2012). Furthermore, most of these reports do not give details as to the specific chemicals involved; but there is even a more disturbing dimension of the issue-pesticide poisonings are hard to diagnose. According to NPA (2012), when

chemicals are taken in smaller quantities their effects on food are difficult to detect and quantify. “Although toxic effects of pesticides on humans and animals are fairly easy to recognize when exposed to large quantities, the effects from long-term exposure to low doses are difficult to identify (NPA, 2012)”. For instance, NPA (2012) further reported that in late 2010, 15 farmers died from suspected pesticide (of the organochlorines family) poisoning in the Upper East region as a result of poor storage of the pesticides, which seeped into food stocks.

Nkoranza Municipality in the Brong Ahafo region is one of the major vegetable producing areas of the country, where a variety of agrochemicals are used. The most commonly cultivated vegetables in the Municipality are tomatoes, pepper, garden eggs, cabbage and sweet pepper. However, to the best of our knowledge, not much has been done in the municipality, by way of finding out the types of pesticides used and their effects on the food intake of the people. It was against this background that we sought to investigate empirically the extent of insecticide application in vegetable production in order to establish any cases of food poisoning in the municipality.

The main objective of the study was to find out the practices with respect to the production, sale and consumption of vegetables for the purpose of establishing possible cases of food poisoning in the Nkoranza Municipality in the Brong Ahafo region of Ghana.

MATERIALS AND METHODS

Study area

The study was conducted in 2011 in the Nkoranza Municipality of the Brong Ahafo region of the Republic of Ghana. The Municipality lies within longitude 1°42'19''W and latitude 7°33'15''N and shares boundary with Techiman Municipality, Amantin, Kintampo and Ejura Districts. The Municipality covers a total land area of 2,584km². It experiences a bi-modal rainfall pattern. The major rains start from April to July and the minor from September to October. The dry season which is highly pronounced in the savannah zone starts in November and ends in March.

Sampling procedure, data collection and analysis

Four communities, namely; Nkoranza-fie, Nkwanbeng, Brahoho and Akuma within the Municipality were purposively selected for the study. These communities were selected due to their high participation or involvement in vegetable production, distribution and consumption. The total population (from the four communities) was then put into strata of producers, consumers and food vendors/vegetable sellers. A total sample of 120 respondents made up of 40 respondents in each stratum was then randomly selected for interviewing. Data collected was analysed using the statistical package for social sciences (SPSS-16) software and Microsoft Excel. This study is mainly explorative and descriptive in methodology.

RESULTS

In this section the findings of the survey are presented. Specifically, the following are presented: Demographic indicators of respondents; Types of vegetables cultivated; Types of insecticides used by the farmers; and farmers' perceptions on the effects of insecticide misapplication on food poisoning.

Age Distribution of respondents

The mean ages of the vegetable producers, consumers and traders were 49.8, 33.6 and 37.8 years respectively (Table 1). Clearly, the producers were on a whole, older than the vegetable vendors, who were also older than the consumers.

Table 1: Age distribution of respondents

Age range	Producers		Consumers		Food Vendors	
	Freq	%	Freq	%	Freq	%
21-30	3	7.5	23	57.5	13	32.5
31-40	8	20.0	7	17.5	14	35.0
41-50	9	22.5	7	17.5	7	17.5
51-60	9	22.5	3	7.5	4	10.0
61-70	11	27.5	0	0	2	5.0
Total	40	100.0	40	100.0	40	100.0

Educational level of respondents

From Table 2, 40% of the vegetable producers and vendors had no formal education, while 47.5% and 42.5% respectively had basic education. The situation is quite different from vegetable consumers among whom 37% and 17% had secondary/technical and tertiary education respectively.

Table 2: Educational status of respondents

Level of Education	Producers		Consumers		Food Vendors	
	Freq	%	Freq	%	Freq	%
None	16	40.0	5	12.5	16	40.0
Basic	19	47.5	13	32.5	17	42.5
Sec/Tech	4	10.0	15	37.5	7	17.5
Tertiary	1	2.5	7	17.5	0	0
Total	40	100.0	40	100.0	40	100.0

Farmers' Access to Extension Services and training

When asked whether they had access to extension services, 90% of the farmers responded in the negative. Similarly, 95% of them had received no training in insecticide application.

Distribution of vegetable producers

Figure 1 below shows the categories of vegetables that are produced by farmers in the study area. The most popular categories are as follows: tomatoes, garden eggs and pepper (19.5%); pepper (12.2%); cabbage and pepper (9.8%) and tomatoes and pepper (9.8%). When asked the purpose of producing the vegetables, 90% of the farmers indicated they produced them for sale, as against only 2.5% who indicated they produced for consumption. However the rest (17.5%) produced them for consumption as well as for sale.

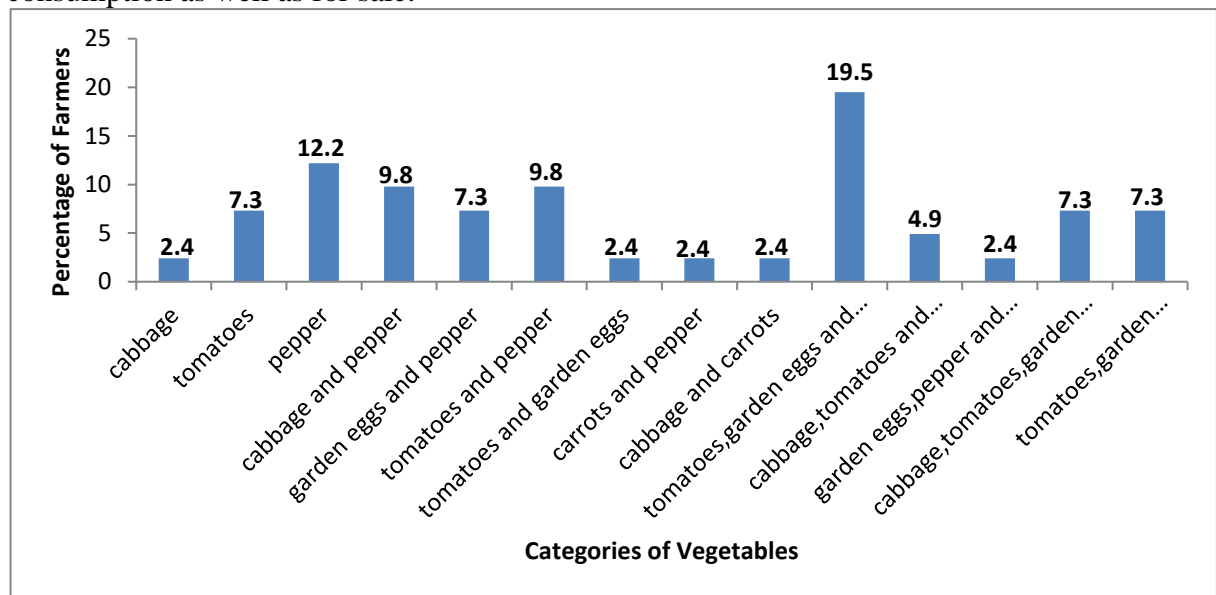


Figure 1: Categories of vegetables produced in Nkoranza Municipality

Farmers' view of the ideal insecticides for vegetable production

The farmers were asked to indicate, in their view, the ideal insecticides for spraying on their vegetables. The most frequently mentioned insecticide was Karate 5 EC [Lambda cyhalothrin (50g emulsifiable concentrate)] (50%), followed by Neem and Karate 5 EC (47.5%) and Karate 2.5 EC [Lambda-cyhalothrin (25g emulsifiable concentrate)] (2.5%). However, when asked to indicate which insecticides they were actually using on their vegetable farms, they indicated several types as shown in Figure 2. As can be observed, the commonest insecticide used was Confidor 2500 SL [Imidacloprid (2500g soluble liquid)] and Karate 5 EC.

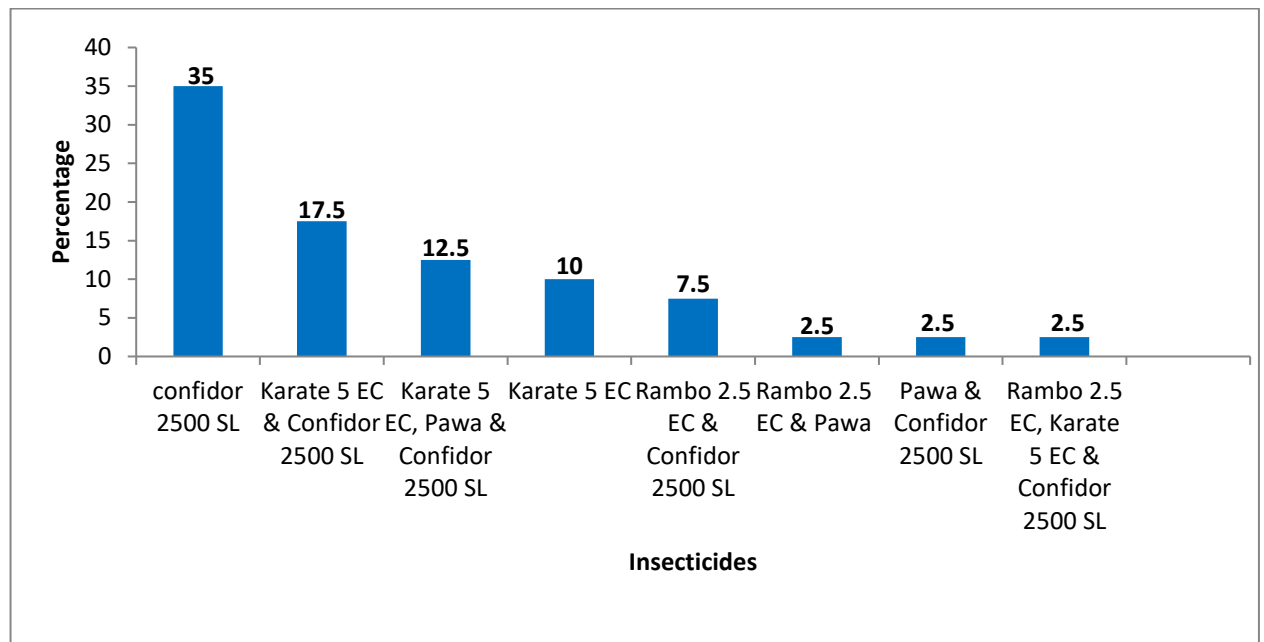


Figure 2: Categories of insectides applied on vegetable in Nkoranza Municipality

Last spraying time of vegetables before harvesting

Another important area of vegetable production that we explored was the time within which the last spraying of vegetables was done before harvesting. From Figure 3, 45% of the farmers indicated they did the last spraying of their vegetables between 30 minutes and 4 hours. Also, while 12.5% and 10% did their last spraying 2 and 5 days respectively, before harvesting, 32.5 did it a week before.

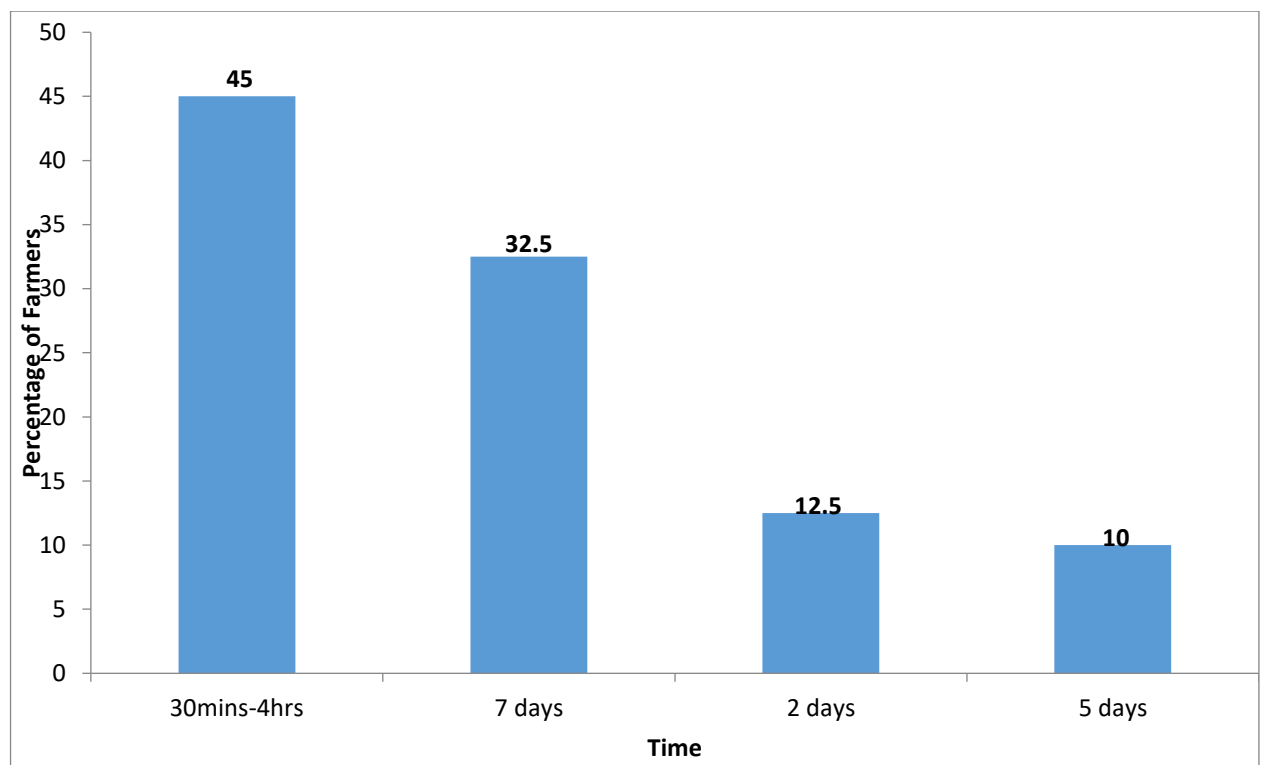


Figure 3: Time of last spraying of vegetables in Nkoranza Municipality

Farmers' perceptions of insecticide related food poisoning

When asked to indicate their views on the causes of food poisoning, with respect to insecticide application on vegetables, 38.4% of the respondents mentioned misapplication of insecticide followed by lack of education (32.3%) and Ignorance (16.6%). The rest indicated a combination of the three as depicted in Figure 4.

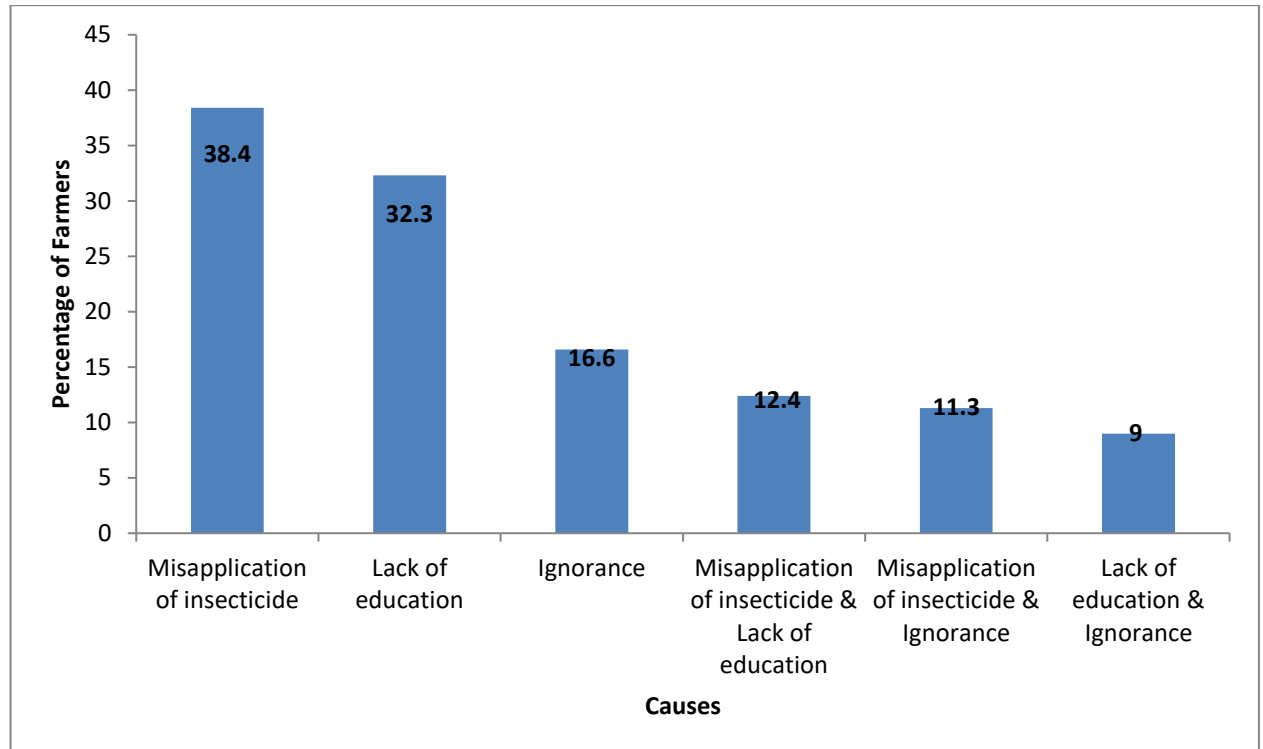


Figure 4: Causes of insecticide related food poisoning in Nkoranza Municipality

Consumers' perceptions of ways of preventing insecticide related food poisoning

As to the ways of preventing insecticide-related food poisoning, the responses were given as follows: Education (43.6%); Use of organic insecticides (30.8%); Follow the instructions with respect to the use of the insecticides (20.5%); and a combination of education and the use of organic insecticides (5.1%) (Figure 5).

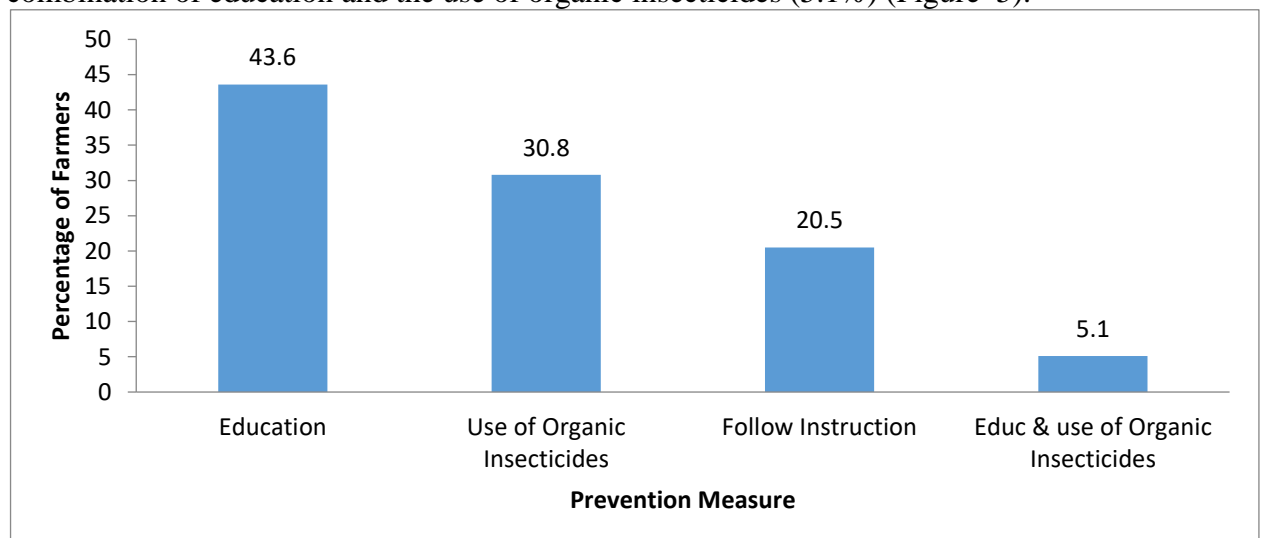


Figure 5 Prevention of insecticide related food poisoning by vegetable farmers

Respondents' perceptions of ways of preventing food poisoning by vegetables sellers and food poisoning

Apart from the producers, vegetable sellers and food vendors were also asked to indicate the ways by which they thought food poisoning could be avoided from their end. From Table 6, Treatment of vegetables came first (54.4%), followed by Education (34.6%); and buying vegetables from a good source (i.e. from a hygienic source).

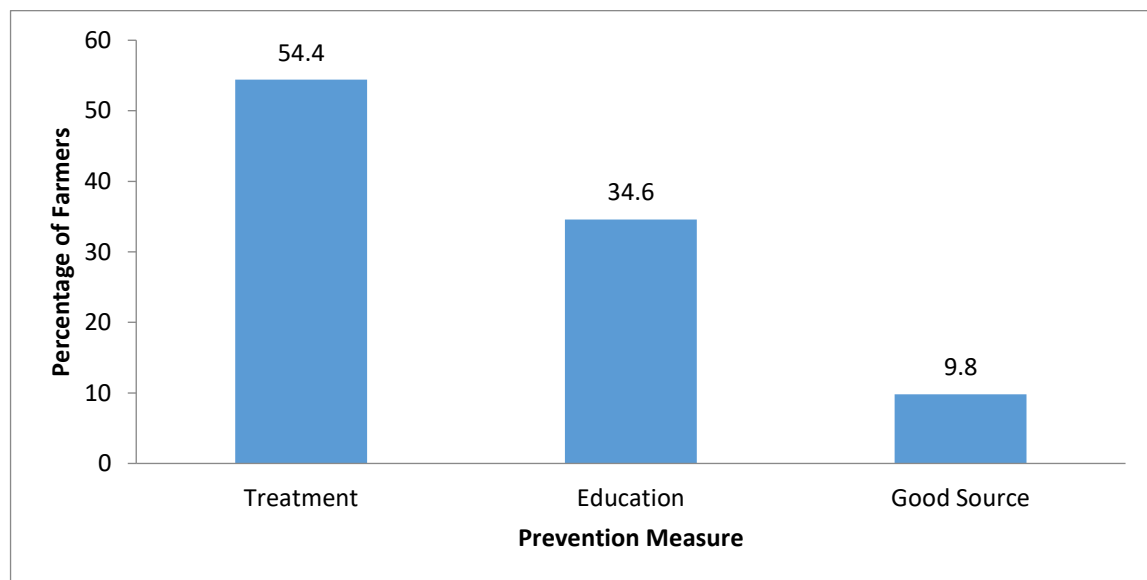


Figure 6 Prevention of food poisoning by vegetable sellers and Food Vendors

Incidence of food poisoning

The ultimate question that respondents were asked was whether they had had incidence of insecticide related food poisoning. Only 7.5% of the respondents answered in the affirmative. However, of the 92.5% who answered in the negative, some said they visited the hospital on some occasions after eating vegetables. An interview with the District health officer confirmed that there had been some reported cases of insecticide-related food poisoning in some of the health centers. He gave an instance in Yefry, a sub district community, where in 2010, two people reported sick after eating tomatoes and garden eggs. The health director could not tell exactly what chemicals were sprayed on the vegetables, but it was believed to be Confidor 2400SL [Imidacloprid (2500g soluble liquid)], a common insecticide used in the area. Not only is this chemical not good for vegetables, sometimes they are sprayed a short time before the vegetables are harvested.

Methods of Vegetable treatment

Figure 7 below shows the methods of vegetable treatment adopted by the respondents in the study area; while 30% used only water, 15.5% used salt solution and 42% used a combination of the two. However, only a small percent (12.5) used vinegar, salt solution or just water.

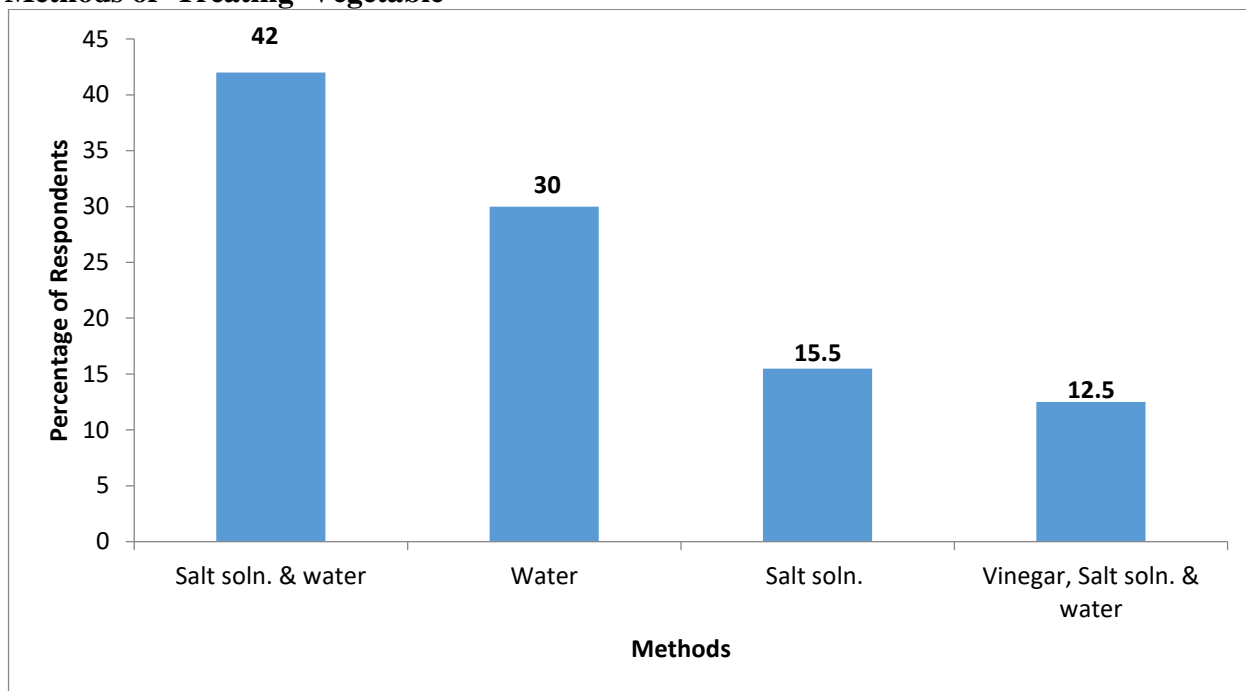
Methods of Treating Vegetable

Figure 7: Methods of treating vegetables in Nkoranza Municipality

DISCUSSION

The results of the study presented above may be summarized as follows: the vegetable farmers were not only ageing, they had low levels of education, as well as limited access to training and extension services. However, vegetable farming was largely commercial. Also, even though the respondents had good knowledge of insecticide-related food poisoning, there was limited use of vinegar in treating their vegetables before consumption. These notwithstanding, there were few reported cases of food poisoning.

With respect to the ageing farming population in the study area, the findings do not come as a surprise considering the fact that, the farming population at the national level is old (Ghana Statistical Service, 2007). In the studies by Adeniji (2008) and Adeola (2012), the mean ages of the vegetable farmers were 46 and 46.5 years respectively. Low educational level of vegetable farmers is also reported by Adeniji (2008) and Adeola (2012). While 60% of the farmers in the former study had had no formal education, in the latter, 60.2% had had only basic education. In terms of access to extension services our findings are in contrast with that of Adeola (2012), where 77% of the farmers had access to extension services. Consequently, he found that among others, the farmers had good knowledge about the negative effects of pesticide use, evidenced by their responses as follows: water pollution (70%); decrease biodiversity (61.7%); Soil degradation (54.7%); air pollution (48.1); and harming beneficial insects (28.1%). In this present study however, even though access to extension service was low the majority of the farmers were able to establish the link between insecticide misapplication and food poisoning.

Farmers' low level of education and limited access to training and extension services, coupled with the fact that they were aged have a lot of implications on insecticide application, in terms of what, how, how much and when to apply insecticides in vegetable cultivation. No wonder, the majority of the farmers in the study area were applying the wrong insecticide and at a wrong time to their vegetables. Even though the farmers thought that Karate and neem were the most ideal insecticide to be used in vegetable farming; they used Confidor, which is more ideal for tree crops like cotton. Their reason was that Karate is no longer effective in killing the insects, hence their resort to Confidor. The question is, should they go for Confidor simply because it is effective, irrespective of its health implications? Horna *et al.* (2008; p.17) reported that 'on vegetables such as cabbage, tomatoes and garden eggs, the current recommendation in Ghana is to apply Karate 2.5 EC at the rate of 200-800ml/ha. In this present study, farmers were not even using the Karate 5 EC which is of higher concentration than the Karate 2.5 EC, but Confidor, which is a far higher chemical. The use of neem extract as an insecticide was introduced to the farmers by one of our research team members, at the pilot study, and so it did not come as a surprise to us that it was not being used by the farmers. In Adeola's (2012) study, as indicated earlier, the pesticides commonly used were Apron plus, Sevin, Cypermethrin and Primextra. Similarly, in Jeyanthi and Kombairaju's (2005) study, the categories of pesticides used were organophosphates, carbomates, pyrethroids and organochlorines.

In the same vein, those who did their last spraying within 4 hours before the harvesting of their vegetables are a source of worry. About 33% of the farmers knew that the right time for the harvesting of vegetables was at least seven days after the application of insecticides but due to financial constraints, and sometimes pressure from the market women, they harvested just after the application of insecticides. This was especially so with tomatoes, garden eggs and pepper farms. Jeyanthi and Kombairaju (2005) also found that it was a regular practice to spray pesticides immediately before or after the harvest in Dindigul district of Tamil Nadu in India. Specifically, they disclosed that on average Chillie and Bhendi were sprayed 13 and 12 times respectively, while Cauliflower and Brinjal were also sprayed 15 times averagely. Horna *et al.* (2008) also observed that 90% of farmers applied dosages of Karate above the recommended rates in single applications, but considerably lower doses than recommended in the aggregate level. They stressed that higher doses than the recommended levels are not only harmful to human life but they contribute to the development of the insects' resistance to insecticides.

Misapplication has to do with the use of the wrong insecticide or a wrong dose and timing of the spraying. The respondents in this present study demonstrated knowledge in the relationship between insecticide-misapplication and food poisoning. In the report of Mahantesh and Singh (2009), 41% of the farmers in their study were aware of pesticide hazards in vegetable production. However, only 9.8% knew about the recommended level of pesticides use in vegetable cultivation. Similarly, Acheampong *et al.* (2012) reported that 44.8% of farmers in their study knew that the consumption of contaminated vegetables caused diseases. Some of the contaminants mentioned were chemical residues (29.4%), worm eggs (23.3%), fungi (16.5%) and human excreta (9.8%). Horna *et al.* (2008) also found the following as the effects of the chemicals used by the farmers: burning sensation on skin (69%); headaches (47%); itchy watery eyes (38.7%); coughing or breathing

difficulty (35.4%); dizziness (33.4%) and nausea or vomiting (13.6%). Ntow *et al.* (2006) however, reported that about 80 % of vegetable farmers surveyed in six (6) regions of Ghana had become ill from pesticide exposure. Some of the symptoms were body weakness, headache and/ dizziness. Lastly, in Horna *et al.* (2008), other symptoms that took 21% of the respondents to a medical centre (whether conventional or traditional) were stomach troubles and loss of appetite, weakness and joint pains, and fainting.

In asking the question why farmers apply the wrong insecticides and at the wrong times when they know about the negative effects of their actions, the answer has often been that they are driven by profit motives. In this study, the fact that the majority of farmers were into commercial farming of vegetables attests to this. The positive aspect of commercial farming is that the farmers can scale up their farms and incomes and be able to pay back their loans. However, there is the need for their activities to be regulated so that human health and nutritional habits are not compromised.

Unlike the vegetable farmers, the majority of vegetable consumers had formal education, similar to the findings by Acheampong *et al.* (2012) where 93% of vegetable consumers had had formal education with 54.6%, 20.1% and 15.5% having primary, secondary and tertiary education respectively. Only 7.2% had no formal education. Similarly, like in our present study, Acheampong *et al.* (2012) found the vegetable consumers in his study to be youthful; 34% of them falling between the ages of 18 and 25 years. Despite the relatively high level of consumers' formal education, they did not adopt the most effective method of treating their vegetables, namely, the use of vinegar. But the limited use of vinegar was not only due to ignorance but also its relatively high cost and inaccessibility, as lamented by some of the respondents.

Insecticide misapplication in the production of vegetables as well as poor or no treatment prior to consumption can have serious implications on human health and nutritional habits. In this study, the incidence of food poisoning was not widespread. However, the fact that some respondents indicated they visited the hospital on some occasions after eating vegetables is a source of worry. Could it be that the people are sitting on a time bomb? As recommended by the farmers, there is the need for education and sensitization, especially for vegetable producers, with respect to the dangers in insecticide misapplication. Similarly, farmers are expected to follow the instructions that have been provided on the labels of the chemicals. The limitation here, however, is the fact that majority of the farmers are illiterate and cannot read the instructions. The way out is for extension agents and input dealers to help by reading and explaining the instructions to the farmers. Again, the problem here is the fact that the extension agents are not enough for the farmers.

As per the findings of this present study, only 5% of the farmers had access to extension staff. There is the need for affirmative action to increase the number of extension agents to help address this issue. Also, input dealers must not put their interest of maximizing profit above the safety and health of society by selling the wrong insecticides to the farmers simply because they are demanding them. One important and sustainable recommendation made by the farmers is the use of organic insecticide in place of the chemicals. To our surprise, as at the time of the

pilot study, most of the farmers in the study area did not know about the neem extract as an alternative to the inorganic insecticide. It was during this time that they learnt about the organic insecticide for the first time, and most of them were willing to adopt it if it was available. There is an urgent need to train the farmers in the preparation and application of the neem extract. Farmers are not only encouraged to adopt organic insecticides; they are also supposed to adopt hygienic ways of cultivating their vegetables. As noted earlier, the consumers in this present study identified buying vegetables from good/hygienic sources as a measure of preventing food poisoning. The problem that consumers face however is that they cannot tell the ultimate source of the vegetables they buy. This is especially so when vegetables are transported away from the production source. The way out is for government to register vegetable farmers and give certification for vegetables produced under hygienic and or organic conditions. However, as identified by the respondents, whether vegetables are produced and transported under hygienic or unhygienic conditions, the onus lies on consumers to do a thorough treatment of vegetables before consuming them. Education on this must also be intensified and the cost of vinegar may be subsidized to increase its patronage.

CONCLUSION

In conclusion, all hands must be on deck, if insecticide misapplication and its consequent food poisoning are to be curbed, or at least, minimized. Farmers need to apply chemicals in a professional manner, but the ultimate would be to adopt organic farming practices in a hygienic manner. Vegetable traders need to also handle vegetables in hygienic ways while consumers and food vendors must do proper treating of vegetables before consuming them. Furthermore, the government must have the political will to ensure proper regulation of the sale of insecticide as well as monitoring and enforcement of the laws to ensure compliance. Finally, in terms of research methodology, we recommend a more quantitative approach to the topic, in order to establish the statistical significance of the socioeconomic factors that influence insecticide misapplication in the study area.

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