Pesticide Misuse in Rural-Urban Agriculture: A Case Study of Vegetable Production in Tano South of Ghana

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ABSTRACT---- ***Urban Agriculture is crucial to the supply of food especially fresh vegetables in many urban areas across Sub Saharan Africa. It serves as a source of employment and income for many urban dwellers. In the Tano South District of Ghana, most urban farmers resort to the use of chemical pesticides in controlling insect pests that they face. This study assessed attitudes of urban farmers towards the use of pesticide, assess the threats they face by using pesticide and together with them, identify alternative ways of pest controlling. By employing convenience and purposive sampling techniques, 132 farmers and 5 other stakeholders were selected for data collection through participant observation, interviews and focus group discussions. Secondary data was used in the study. The use of chemical pesticides was found to be the sole means by which the farmers controlled pest. The farmers feel spraying with chemicals is not only effective; it is also the only viable option available to them at the moment. Even though they are aware of other pest control strategies such as Integrated Pest Management (IPM), they lacked in-depth knowledge about the principles of IPM and hence employ it to control pests. The use of pesticides poses serious health hazards to both farmers and consumers of fresh vegetables, in addition to the serious environmental damage it causes. The Tano South farmers reported health conditions such as dizziness, skin and nausea irritations are some health conditions reported by the farmers after spraying. Health issues arise through this is mainly due to the inappropriate handling and mixing of the chemicals as well as the non-use of personal protective clothing on the part of farmers during spraying. Pesticide residues on vegetables and other food products due to indiscriminate spraying also pose serious health threat to consumers and the environment. Even though the farmers rely only on pesticide as a way of controlling pest, they are willing to adopt sustainable pest control strategies such as IPM. However, they are calling for serious research and training on the part of government so that whatever alternative strategy introduced to them can be effective in controlling pest to facilitate adoption.***

Keywords--- Pesticides, Ghana, integrated pest management, urban farmers

1. INTRODUCTION

Rural-Urban Agriculture (RUA) has been identified as an important source of food, including fresh vegetables for many cities in Sub-Saharan Africa (Cofie, van Veenhuizen, & Drechsel, 2003). In Sunyani, the capital of Brong Ahafo Region, Rural-Urban Agriculture is credited with the supply of large chunk of fresh vegetables such as *Solanum lycopersicum, Brassica oleracea var capitata, Allium cepa Lactuca sativa* which are in high demand due to the cosmopolitan nature of the city (Coffie et al., 2005). Apart from satisfying the dietary needs of the ever-increasing population of urban areas, rural-urban agriculture is also a critical source of employment for the many small-scale farmers who are involved in this venture and thereby enhancing their livelihoods and alleviating poverty (Cofie et al., 2003; FAO, 2008). Rural-Urban Agriculture in Sunyani can be categorized into two groups: backyard gardening and open-space farming (Adeoti, Cofie,& Oladele, 2012). Backyard gardening takes place in and around homes and it is estimated to cover an area of 80-90 ha which is distributed over about 80,000 tiny backyards within the metropolis. The size of land used for open-space farming is estimated to be about 980ha of which dry season irrigated vegetable production accounts for about 100ha (Obuobie et al., 2006) Obuobie et al.(2006) contended that, there are about 1000 vegetable growers in Sunyani and they have plot sizes ranging between 1 to 10 per farmer. Urban farmers in Sunyani produce mainly hybrid vegetables due to their high demand but open pollinated varieties (OPVs) vegetables are also grown even though much of the city's traditional vegetables are produced and supplied by farmers in the rural and urban areas. Exotic vegetables are non-traditional vegetables such as *Brassica oleracea var capitata, Allium cepa,Capsicum annuum C. Lcatuca sativa, Citrullus lanatus, Solanum lycopersicum*. Traditional vegetables are used mainly for the preparation of local cuisines. They include *Abelmoschus esculentus*, *Solanum lycopersicum*, *Solanum melongen*a L. Pesticides (Drescher, 1997). In Benin(Williamson, 2003) found that, fruits and vegetable farmers often use unregistered products or pesticides meant for cotton production on their crops.Urban farmers in developing countries are the most vulnerable to pesticide problems because they lack information on safe usage and health hazards. Until the mid 80's about 50% of global pesticide

poisoning and 80% of deaths occurred in developing countries though developing countries accounted for only 20% of global pesticide usage (Smit, Nasr, & Ratta, 1996).Studies have often highlighted the poor pesticide practices among African farmers including rural-urban farmers. These practices includes inefficient and sometimes dangerous practices such as the use of inappropriate products, mixing different pesticides-a phenomenon known as pesticide cocktail (Williamson, Ball, & Pretty, 2008) Furthermore, incorrect dosages are often administered due to non-calibrated and sometimes leaking equipment that are used for pesticide application. Pesticides are also sometimes applied at the wrong time -sometimes spraying is done too close to harvest.(Ackerson & Awuah, 2010; Williamson et al., 2008). Extensive pesticide use, and in most cases misuse, has therefore become the hallmark of urban agriculture in Brong Ahafo Region (Amoah, Drechsel, Abaidoo, & Ntow, 2006; Fianko, Donkor, Lowor, & Yeboah, 2011).

Even though there are adequate legislations to regulate the manufacture, importation and use of chemicals including pesticides in Ghana,(GEPA, 2007; Gerken, Suglo, & Braun, 2001; "Pesticides Control and Management Act," 1996), the absence of effective governmental control mechanisms as well as lack of technical capacity on the part of state agencies has resulted in the non-enforcement of these regulations(L. Probst et al., 2012). The confluence of non-enforcement of regulations, absence of market standards, inadequate knowledge about alternatives to pesticide use such as Integrated Pest Management(IPM), the proliferation of pesticide on the Ghanaian market and the non-existence of market for organically produced vegetables perpetuate farmers 'reliance on pesticide to control the high and changing pest pressures they face on their farms.

Although the use of pesticide has contributed tremendously in ensuring regular supply of fresh vegetables to urban markets in Ghana, this has happened at a cost. The health implications of the excessive and in most cases indiscriminate use of pesticide have been enormous.

Research has established many dangers posed by pesticides to the health and wellbeing of both farmers and consumers as well as the adverse effects of these chemicals on the environment.
In many western countries, customer awareness of the hazards of pesticide use has been pivotal towards the increase in the demand for organically produced food (Spiertz, Haverkort, & Vereijken, 1996). Consumer awareness and demand for pesticide-free food is therefore a major force which can lead to the decrease in pesticide use and concurrently increase the production of organic food in Ghana. However, research carried out in Ghana to investigate the willingness of consumers to buy vegetables that has been produced without pesticides found that, only highly educated people who in most cases are also high income earners, understand the high risks associated with the misuse of pesticide. Not surprisingly, these people also happen to be the ones who knew about organic food. Majority of consumers were more interested in prices and attractiveness of the product (L Probst, Aigelsperger, & Hauser, 2010).It is therefore very unlikely that farmers would be forced to abandon pesticide use any time soon since there is no demand for pesticide-free vegetables coming from consumers.

Most studies on pesticide use in Ghana have focus on identifying the hazards of pesticide on the health of producers and consumers. In spite of the awareness of the adverse effects of pesticides, there is no sign that farmers are shifting to different pest control methods.

1.1 Problem Statement

The heavy use of pesticides has resulted in various negative healths, environmental and economic consequences (Essumang et al., 2009; Tariq et al., 2007). The Food and Agricultural Organization (FAO) FAO (2008), has been concerned about various reports of ill health associated with those applying pesticides. The World Health Organization had estimated that a million people were being poisoned annually with 20,000 cases resulting in death (WHO, 2006). Much of this problem was due to the toxicity of the pesticides that are used by many farmers but without adequate knowledge and failure to wear appropriate protective clothing. Health problems associated with pesticide application are usually blamed on the pesticides without considering how they are applied

1.2 Justification

Pesticides abuse and misuse is common in Ghana and in Africa, although the use of pesticides in Africa represents a small fraction of the global total, misuse is disproportionately high factors that lead to these high misuse rates include the high illiteracy levels and inaccessibility to reliable protective clothing. Smuggled products, unregistered products, open air sales, sale of banned product, cases of decanting and reweighing, faking of pest control products using counterfeit labels, sale of expired products with modified expiry dates are among the misuse cases that have been reported in Ghana. Spraying mistaken products has led to the dead of hundreds of flock. To promote appropriate use of pesticides and applications, it is critical to understand the current use of pesticides among farmers, who are the majority of the Ghanaian agricultural labor force. Until now, there have been no published reports regarding the actual behavior of farmers' pesticide use and applications patterns. For this reason, this study was conducted to determine pesticide use and application among farmers in Tano South District, Ghana.

1.3 Hypothesis

There is no misuse of pesticides and applications among farmers.

1.4 Objective

The objective of my research is therefore to get a deeper understanding of rural-urban farmers' attitudes towards the use of pesticide, assess the threats they face as a result of pesticide application and together with the farmers, identify alternative ways of controlling pest.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The study was carried out in Tano South District. The district lies between Latitude $7^0$00` N and 7 $^0$25`N and between Longitudes $1^0$45`W and $2^0$15`W. Bechem is the district capital. The district is bounded on the North and East by the Offinso and Ahafo Ano South Districts, both in the Ashanti Region. On the South, it is bounded by the Ahafo-Ano North District, also in the Ashanti Region and on its West and South-West by Tano North Disttrict Assemmbly. The total land area of about 1,500 square kilometers, which is about 3.8% of the total land area of the Brong Ahafo Region. Three main zones namely, Bechem, Techimantia and Derma were selected in the district for the study. These areas are mainly agricultural provinces where the population produces vegetables, cereals, legumes and others. The majority of these vegetable products are sold on the national market or exported. The survey sites selected were based on the proportion of full-time farm populations, cooperation from local leaders, and the willingness of farmers to participate.

2.2 Data Collection

The data was collected by means of a structured questionnaire (Appendix 1) for information on farming systems, pesticide use and practices, applicator precautions/averting behavior and health/ environmental effects. The survey was divided into two major sections, one dealing with the socio-economics of pesticide use (for example production, pesticides used, protection, training, etc.) and another strictly dealing with the health of the farmer (for example questions on self-reported health ailments/ health-related habits, a general physical exam, and patch-skin and blood tests for pesticides).The survey was conducted during November 2014-January 2015. To minimize any possible reporting bias, the survey was conducted under agreement that the team would not reveal the identity of the farmers surveyed

2.3 Study design

The Tano South District was selected for this case study out of the other vegetable production areas by using purposive sampling technique. This site was selected because vegetable production has been done here for many years. Some farmers have intensively been growing vegetables at this area for more than 30 years by relying on external inputs such as pesticides, fertilizers and irrigation. Convenience sampling was used to select 85 farmers at the site for the study while purposive sampling technique was used to select 6 Agricultural Extension Agent (AEA), and officers from the Plant Protection and Regulatory Services of the Ministry of Food and Agriculture, agro chemical shop owner and officers from the Environmental Protection Agency (EPA). In order to answer the research questions, participant observations, in-depth interviews and focus group discussions were used to gather data for this study.

Participant observation and in-depth interview were used to gather data to answer research questions while secondary data derived from published journals and project reports were relied upon to answer research questions. These data collections methods were employed in a systematic manner. In the first place, I visited the site for two weeks observing what the farmers were doing on a daily basis at the vegetable production areas. Thereafter, with the aid of a semi-structured interview guide, interview sessions were conducted with 85 farmers. A focus group discussion was then held at the site with the farmers who were interviewed.

Interview sessions were also held with the District Director of Agriculture, an Agriculture Extension Agent in charge of the vegetable farmers, an officer from the Plant Protection and
Regulatory Services of the Ministry of Food and Agriculture (MoFA), an agro chemical shop owner and an officers from the Environmental Protection Agency.

During the interview sessions, interviewees were assured of both confidentiality and anonymity. They were also assured that information obtained would be used solely for academic purpose.

3. RESULTS

3.1 Pesticides Use at Tano South District: Attitudes and Reinforcing Factors

Farmers at Tano South District grow mainly cereals, roots and tuber, vegetables and legumes. Their reason for exclusively growing of vegetables is simple; vegetables are early maturing, the demand is high and there is a quick return

on investment. More than half of the farmers at the site are migrants who are in the city of Bechem for better economic prospects. Even though most of them have farmed before migrating to Bechem, they did not necessarily do vegetable farming. Adusei Mensah, a 46year old man who has been farming at Derma for the past10years had this to say:"I migrated to Derma 9 years ago for better economic prospects. When I arrived, it was very difficult to find a job so I worked as a casual labourer at the site. After working for 3 years, I took over this plot from an older farmer, when he was unable to farm again, to grow my own vegetables. Even though I was farming before coming to Derma, I had no experience with the growing of exotic vegetables soI had to learn from the older farmers at the area. Growing of vegetables is very rewarding if you compare it to other jobs in Derma which is available to people like me". The intensity of vegetable production means that the work load is heavy and older farmers need extra labour. While some rely on casual labourers, most of them rely on young men who want land at the area (these young men are usually family members or sometimes tribesmen) to provide labour and learn the rudiments of rural-urban vegetable production. This is one of the ways through which people usually acquire land for farming at the area since the land does not belong to any individual.

Sarfo Adu Eric, who has been growing vegetables for 5 years noted: "I leant how to grow these exotic vegetables from my uncle. The space I am using now to grow my crops is where my uncle used to farm. He taught me most of the things I know about growing vegetables. I also leant certain things from the extension people. My uncle is getting old now so he doesn't come to the farm anymore. Even though the land technically still belongs to him, all the crops I grow are mine but I give him money after I sell my vegetables because he has no source of income."(Sarfo, vegetable farmer/Bechem).

Farmers at the area do not have a specific sequence for growing their vegetables. Each farmer grows what he/she wants in response to market demand. Tomato, garden eggs and sweet pepper, are the most commonly grown vegetables at the area even though vegetables like cabbage and lettuce were found on some plots at the area. According to the farmers, tomato and garden eggs were their favorite choice because they are not only in high demand in the city, the perishable nature of these vegetables hinders their supply to the Techima, Kumasi and Accra markets from the rural areas. The farmers cite diseases and pests as their biggest challenge followed by access to land. Some other concerns were high cost of inputs and lack of support from government.

With regards to diseases and pests, the farmers were more worried about the later than the former. Felix Otasi, a 55 year old farmer had this to say about diseases and pest: "We face problems with both diseases and pest as vegetable farmers. With the diseases, it can be minimized by buying certified seeds. Our biggest concern is with the insect pests issue. If you do not control them by spraying, you can lose your entire harvest.''(Felix Otasi, vegetable farmer, Techimantia).The incidence of pest, according to the farmers, was not only severe; it is also on the ascendancy. The older farmers explained that, when they started farming at the site, only cabbage required spraying against insect pests but the situation is very different now. The pest situation is so severe these days that, they recon, it is almost impossible to grow any vegetable there and successfully have a harvest without spraying pesticides. Kwame Owuso observed: 'At first, we never sprayed these crops (pointing his finger to a raised bed of Tomato). Not a single pest attacked it from planting to harvesting. But now, you cannot grow it without spraying. That is how serious it is now''.(Kwame Owuso, vegetable farmer/Bechem).Thrips, aphids moths and white flies were the most common insect pests farmers mentioned which frequently attacked their vegetables. Nematodes were also a concern to the farmers. Among these pests, thrips were singled out as the most destructive on vegetables at the site especially on *Solanum melongena* and *Capsicum annuum* C. Yakubu Yahaya, who has been farming at the area for 5years, had this to say about thrips:''Those insects (thrips) are becoming more and more destructive. In the past, they were easily controlled by spraying just a few times. But now, if you grow garden eggs and you do not spray regularly, they will destroy all the crops.''(Ahmed, vegetable farmer/Techimantia).

The use of chemical pesticide is the sole means by which the farmers control pest. Most of the farmers did schedule spraying (calendar spraying) which ranged from once a week to as high as four times a week. The intensity of spraying is based primarily on the sighting of pest on the vegetable crops.

Even though most of the farmers said the AEAs give them directives as to how and when to spray, they conceded that most spraying schedule is based on their experience as well as the presence or absence of pests on the vegetables. Younger farmers also said they follow the recommendations from older/experienced farmers as to what pesticide to use and when to spray.

The farmers regard chemical pesticide as the only effective means of controlling pest. All the farmers spraying their crops during the study were of the view that, after doing their schedule spraying, they are rest assured that their crops will be saved from pest damage. They pointed out that, they have a lot of other things to do so just leaving the crops at the mercy of the pests hoping that they will not do economic damage was not an option for them. Spraying, they say, give them the guarantee that, they will have a harvest and subsequently make some income.

Chemical pesticides used by the farmers are bought from commercial agro input shops which are scattered across the district. Even though the farmers are the ones who usually go to the agro chemical shops to buy the chemicals, they (the

farmers) are sometimes also given chemicals by the agro input shops to try (especially when there is a new pesticide, the input dealers sometimes give the farmers samples to try). Agro input dealers need a license from the Environmental Protection Agency (EPA) to handle and sell pesticides; and they are require to have basic knowledge in handling of chemicals in order to obtain a license.

However, Agro input dealers are not restricted as to who to sell what chemical to. They only give farmers extra information when farmers ask and there is even no guarantee that the information they give to farmers are right since most agro input dealers are not highly educated themselves. To them (the agro input dealers), selling pesticides and other agro inputs is purely business and the responsibility is on the farmers to use the chemicals in the right way. "Farmers come into the shop and tell us what they want to buy. If the product is available, we simply sell it to them. Sometimes too, the farmers come in and tell us they are growing this or that crop and it has been destroyed by insect pests so they want some pesticides to control them. In that case, we give them the chemicals that can kill the insect pests. The chemicals help the farmers a lot because without it, the insect pests will destroy all their crops''. (Wofa Fusheini, Agrochemical shop owner-Derma)

Furthermore, to drive sales, major agrochemical input distributors employ the mass media especially radio and TV to aggressively market agrochemicals to farmers as the panacea to all their weeds, disease and insect pest problems. This goes a long way in making the use of pesticides to control pests very attractive to farmers.

Most pesticides in Ghana are imported by private companies after obtaining a license from the EPA. An official from the EPA had this to say about the importation and registration process: ''The manufacture, importation, storage and distribution of chemicals, including pesticides, are governed by the EPA Act (490). According to the Act, before a company manufactures or imports pesticide, a dossier about the product must be presented to the EPA for approval and registration by the agency's technical committee. After registration of the product, one also needs importation and distribution license from the EPA.''(EPA official).

The EPA, as their quality control measure at the field level, also randomly sample pesticides in the market for testing. Pesticides that are found to be different in chemical composition from what was registered with the agency are banned. Education and the proper handling of pesticide by farmers, according to the EPA official, is however the responsibility of the MoFA.
The Plant Protection and Regulatory Service Directorate of the MoFA is mandated to organize, regulate, implement and coordinate the plant protection services needed for the country in support of sustainable growth and development of Agriculture. The goal of the directorate is to reduce crop losses to diseases and insect pests while at the same time substantially reducing the use of hazardous chemicals. The directorate does not only provide comprehensive diagnostic and identification services of plant pests and diseases, it also serves as a secretariat for the National IPM Programme. According to an official of the directorate: 'We are responsible for monitoring diseases and insect pests' situation in the country'.

The directorate is also responsible for ensuring effective control of diseases and pests. Even though the national plant protection policy is IPM, most farmers still rely mainly on chemicals for the control of diseases and pests. We disseminate our IPM strategies to farmers through AEAs. Like the Extension directorate who disseminate our strategies to farmers, we are seriously challenged by finance and personnel numbers and that is why IPM has not been widely adopted by farmers.''(Official of Plant Protection and Regulatory Services). The Extension directorate of the MoFA, who are supposed to educate the farmers and monitor their activities such as the use of agro chemicals, is seriously challenged by limited financial resources and personnel like most government agencies. There is therefore a high AEA to farmer ratio which makes their work ineffective. They also lack official means of transportation and this makes it very difficult for them to reach many of the farmers who are scattered across the city.

''The number of farmers each AEA has to serve is many and so we are unable to reach all of them. Apart from the large number of farmers a single AEA is assigned to also lack means of transport. We are therefore unable to seriously and effectively monitor the activities of the farmers in their farms with regards to their handling and use of agro chemicals. We give them advice on the use of pesticide from time to time but we aren't able to monitor them and we are aware some of them are over-applying these chemicals but as it stands now, there is very little we can do''.(Karim, MoFA/Derma). Farmers at the Derma use different types of pesticides to control different pests although some farmers admitted that they sometimes mixed some of the chemical before spraying.

Table 3.1: Common pesticides used by vegetable farmers at the Tano South District (Source, Field work. 2015):

Trade Name	**Active ingredient**	**Chemical group**	**Target pests**
Actellic	Pirimiphos-methyl	organophosphorus	Aphids, caterpillars
karate	Lambda cyhalothrin	Pyrethoid	Mites, thrips
Attack 1.9EC	Emamectin Benzoate	Avermactin	Moths, thrips
Thorex	Endosulfan	Organochloine	Caterpillars
Furadan	Carbonfuradan	Carbamate	Nematodes, white flies

Neem*	Azadirachtin	-	Insects

*Biopesticide

Some of the farmers are familiar with biopesticides. Neem extract was introduced to the farmers in1998 as a biopesticide as part of an IPM programme. According to the farmers, they did not adopt the neem as a biopesticide because they found the extraction of the active ingredient from the seeds and leaves of the plant laborious and time consuming.

Apart from the extra time burden required for the extraction of the neem, the farmers said the neem biopesticide was not effective in the dry season. The neem extract, as a biopesticide, is however now commercially available and some farmers have bought samples for trail. Vegetable farmers at the site were introduced to the concept of ''IPM''during in 1998 through Farmer Field School (FFS). Even though most of the younger farmers were not farming at the site during that time, all the farmers said they have heard of IPM. According to the District Director of Agriculture: 'Vegetable farmers in the district, through FFS, were introduced to IPM in 1998. We are aware that the IPM was not well adopted by the farmers and they are still using pesticide as their sole means of controlling pest. But I think the concept of IPM will catch on with time. For instance, when we first introduced farmers in the region to planting their crops in rows, it was not immediately adopted but now if you travel around, you will see that most farmers plant in rows. The FFS is an effective way of introducing farmers to new farming techniques but it is very expensive that is why we have not been able to do it again for a long time.''(District Director of Agriculture/Tano South). The most common thing about IPM the farmers knew was the fact that not all insect they see on the vegetables were pest and they referred to the beneficial insects as ''insects which are farmers' friend''. They are also aware that, they are not supposed to spray pesticides whenever they see insects on the crops. Cultural methods of controlling pest such as the use of 'clean' planting materials and crop rotations are also things they know. However, the farmers maintained that, they could not do proper rotations because the plot sizes were very small and even if you decide to rotate your vegetables, your neighbor might plant the same vegetable you are trying to rotate. It was however clear during the research that the farmers did not understand the principles of IPM in its' entirety and they feel that spraying with pesticide is their only effective option. Their knowledge about other pest control strategies such as IPM was limited and they do not even believe vegetables can be grown profitably at the site without spraying with chemicals to control pests. One of the farmers remarked: ''it's not that we like spraying the vegetables with chemicals. Remember we and our children also eat the vegetables. The truth of the matter is that, it is just not possible to grow the vegetables without spraying. If you decide not to spray, the insect pest would destroy everything. If you say we should not spray to control the insect pests, what should we do to protect our crops from being totally destroyed by the insect pests?''(Robert, vegetable farmer/Bechem). The farmers in the district lack in-depth knowledge about alternatives to chemical use. Their lack of knowledge is rooted in the absence of routine training for farmers on alternatives to the use of pesticides.

Even though the farmers have not had access to proper training on alternatives for many years, they have still been controlling the pests. Pesticide is what has worked for them all this while and so the farmers have favorable opinion about pesticide use because it gets the job done for them.
Farmers therefore see the spraying of chemicals as the an effective way of controlling the pest and this spraying is embedded so deeply in the production process that, it has almost become an intrinsic part of the of the husbandry activities in the production of vegetables at the site.

3.2 Documented Threats of Pesticide Use in Urban Agriculture in Ghana.

It is estimated that, about 87% of Ghanaian farmers use chemicals to control insect pests and diseases on vegetables (Dinham, 2003). In a survey by (W. J. Ntow, Gijzen, Kelderman, & Drechsel, 2006), farmers cited the presence of pests as a major indicator for pesticide application and wore no or only partial protective clothing. The excessive use of pesticides by farmers, who in most cases misuse the chemicals, has brought about many adverse effects of pesticide application. Literature is therefore replete with the deleterious effects of pesticide use in rural-urban agriculture in Ghana on both human health and the environment. Ntow, Gijzen, Kelderman, and Drechsel (2006) in their study of farmer perceptions and pesticide use practices in vegetable production in Ghana found body weakness, headache and dizziness as the most frequently reported possible pesticide poisoning symptoms among farmers surveyed. Studies conducted by Mensah, Yeboah, and Akman (2004) found that, in Akomadan and Afrancho, where farmers intensively use pesticides, about 56% of farmers had experienced sneezing , skin irritation (65.9%), headaches (48.2%), dizziness (40.0%), abdominal pains (20.0%) and cough (57.6%) after spraying. About 30% of the farmers were also found to have low red blood cells while 38% had low white blood cells. Other health problems farmers face due to the improper handling and application and in most cases over-application of pesticide ranges from nausea/vomiting, blurred vision to death (including children) (E. Mensah, Amoah, Abaidoo, & Drechsel, 2001).

Research has established that, even at low concentrations, persistent synthetic chemicals like pesticides have the ability cause suppression of immune response and hypersensitivity to chemical agents (Fianko et al., 2011). Infertility has also been strongly linked with pesticide use at Akumadan. Miscarriages, stillbirths and impotency are reported to be on the increase at Akumadan in recent years. The high health risks farmers face from the use and handling of pesticide is mainly

due to the fact that most farmers (who usually have just basic or no education) have little or no training in pesticide use (Dinham, 2003) and hence do not handle and apply the chemicals in the required way.

There is also limited or non-use of personal protective clothing due to financial constrains as well inconveniences and discomfort in working when wearing personal protective clothing because of the high heat in the tropics (Ackerson & Awuah, 2010).

The high levels of pesticide residues on vegetables being sold in urban markets (Bempah, Buah-Kwofie, Enimil, Blewu, & Agyei-Martey, 2012; Darko & Akoto, 2008) indicates that, the dangers of excessive pesticide use and misuse are not restricted to only farmers but vegetable consumers are also at great risk of pesticide poisoning. It has been established that, some vegetables especially tomatoes are sprayed with pesticides at maturity and immediately harvested for marketing, a situation which is very dangerous for consumers (Fianko et al., 2011). Laboratory analysis of vegetables such as lettuce, cabbage, tomato and onion in markets in Ghana found detected chlopyrifos, lindane, endosulfan, lambda-cyhalothrin, as well as DDT residues (W. Ntow, 1998). Ntow (2001) found pesticide residues in human fluids such as blood and breast milk of vegetable consumers.

In another study, researchers found chlorpyrifos in six out of eight samples of waakye (a popular Ghanaian dish made of rice and beans) and one out of eight samples of fufu (the favourite food for most southern Ghanaians made from cassava and plantain dough) (Fianko et al., 2011).
Another study also detected fourteen (14) different organo chlorine pesticides in the breast milk of nursing mothers in the suburb of Accra (Tutu, Yeboah, Golow, Denutsui, & Blankson-Arthur, 2011). Studies by Essumang, Dodoo, Adokoh, and Fumador(2008) confirmed high pesticide residues in tomatoes in urban markets with human risk assessment showing cancer risk for both adults and children due to the presence of endosulfan and chlopyrifos.

Table 3.2: Pesticide residues and their concentration levels in different foods in Ghana.

Area	Commodity	Detect	Concentration (ug.kg^{-1})
Kumasi Abattoir	Beef fat	Lindane	4.04
		Endosulfan	21.35
		Aldrin	2.06
		DDE	118.45
		DDT	545.24
		Dieldrin	5.25
	Beef	Lindane	2.07
		Endosulfan	1.88
		Aldrin	1.43
		DDE	42.93
		DDT	18.83
		Dieldrin	5.92
Area	Commodity	Detect	Concentration (ug.kg^{-1})
Buoho Abattoir	Beef fat	Lindane	1.79
		Endosulfan	2.28
		Aldrin	4.11
		DDE	31.89
		DDT	403.82
		Dieldrin	6.01
	Beef	Lindane	0.60
		Endosulfan	0.59
		Aldrin	0.73
		DDE	5.86
		DDT	10.82
		Dieldrin	11.48
Kumasi	Cheese	DDE	31.50
	Yoghourt	DDT	42.17
	Milk	DDT	12.53
Lake Bosomtwi	Fish	Endosulfan	10.06
		Lindane	0.126
		Endosulfan	0.713
		DDE	5.23
		DDT	3.64

		Aldrin	0.018
		Dieldrin	0.035
Kumasi	Luttuce	Lindane	300
		Lambda cyhalothrin	500
		DDT	400
		Chloryrifos	1,600
		Endosulfan	400
Area	Commodity	Detected	Concentration (ug.kg^{-1})
Kumasi	Vegetables	Chloryrifos-methyl	94.0
		Chloryrifos	153.5
		Dichlorvas	86.5
		Dimathioate	117.5
		Malathio	209
		Monocrotophos	61.5
		Omethioate	61
		Parathio methyl	31
		Parathio	71

Source: Fianko et al (2011)

Apart from health hazards for both farmers and consumers, the use of pesticide also has serious environmental implications. Several studies have documented the contamination of pesticides to non-target sites such as surface water bodies and underground aquifers in Ghana which makes water unsafe for consumption by humans as well as wildlife. Even though these aquatic environments are usually non-target destinations of applied pesticides, they are being contaminated by pesticides through direct runoff from farmlands, leaching, inappropriate disposal of empty containers and sachets as well as the washing of equipment (Tariq, Afzal, Hussain, & Sultana, 2007). A study by William J Ntow, Drechsel, Botwe, Kelderman, and Gijzen (2008) detected high concentrations of pesticides in both the water (dissolved) and the streambed sediment (adsorbed) of two streams as aresult of runoff from vegetable farms. In their analysis of water and fish samples from different lagoons in Ghana, (Essumang, Togoh, & Chokky, 2009) found the presence of organo chlorine and organo phosphosphorus pesticide residues as well as bioaccumulation of pesticide residues in fish at levels which could be harmful for humans.

In their study of the effect of pesticide application rate on yields of vegetables and soil microbial communities, Glover-Amengor and Tetteh (2008) found that, high doses of Lindane (a pesticide which is banned but still used in many developing countries) did not increase yields. Moreover, the use of pesticide was also found to suppress the population of soil microbes. The use of Lindane reduced both fungal and bacteria populations by 50-70% and 23.0–38.4% respectively; a situation which can have deleterious effect not only on soil fertility, but also on other soil physical properties.

The environmental impact of pesticide use can be huge. Feeding birds and other wildlife are susceptible to negative effects of grains coated with mercury. Several species including fishes and other aquatic creatures have experienced reduction in procreation and increased mortality. The adverse effects of pesticide use has therefore led to wildlife distress, disruption with reproduction, birth defects as well as depressed immunity which negatively affect wildlife numbers and the ecosystem as a whole (Fianko et al., 2011).

3.3 Reducing Pesticides Use and Searching for Alternatives

Even though the Tano South District vegetable farmers are presently using pesticide as their sole means to control pest, they are willing to adopt other effective pest control strategies if they receive the needed technical assistance. Some of them pointed at the fact that, they have voluntarily purchased the neem extract (biopesticide) that is now commercially available for trails and if they find it effective, they would be switching to that even though it is more expensive than the chemicals they use.

In order to facilitate the adoption of other pest control strategies such as IPM, the farmers identified research as a vital step that needs to be undertaken by government and NGOs in order to successfully introduce other pest control strategies. Ali, who has been growing vegetables at the site for more than 10 years and current secretary for the Derma Vegetables Farmers Society stated that: 'We are willing to adopt other strategies that will reduce our dependence on the chemicals. If they bring the IPM and they train us on how to go about things and it works, why not? But we are just farmers not researchers. So if people are saying that we should not use the chemicals, let government and the researchers bring us different strategy. But the bottom line is that, the strategy must work be it IPM or whatever.''(Fusheni, vegetable farmer/Derma).

In the area of research, the farmers wanted researchers to find out the causes of the increasing numbers of insect pests they are encountering since they clearly felt that the pest pressure was on the ascendancy, a situation which makes them

apply more chemicals. They also called for the research to be 'local' because they were of the view that most often, recommendations for certain practices are based on research done elsewhere and so sometimes they do not get the desired results because the local conditions might be different.

With regards to alternatives to pesticide use, when IPM was suggested, the farmers did not hesitate to voice their concerns. Even though, they were for it in principle, some of them were a bit skeptical about its effectiveness meanly because they lacked in-depth understanding and knowledge about it. For instance, the older farmers who were present during the FFS where IPM was introduced to them were not enthused about what they termed the 'reactive' nature of this pest control strategy. They were of the view that, as farmers, they needed to protect their crops and so if they see pests, waiting to see if they would do economic damage before they start controlling them is far too risky for them. They were also concerned about the 'complex' nature of IPM and wondered if the tight time schedule of most of the farmers will allow them to fully follow the principles of IPM to bring about effective pest control.

Nonetheless, they were opened to the idea of shifting from solely depending on pesticides and controlling pest using IPM if it proves effective. To boast confidence in IPM and facilitate adoption, the farmers said an easier way that can happen is for researchers to get a demonstration plot at the area where they will see the results for themselves. If this is done successfully, they recon, it would remove all doubt and skepticism they have about IPM.

As far as training on new pest control measures such as IPM is concerned, the farmers identified 'coordination' as the key for successful training. The informal nature of their work and the fact that some of the farmers have other jobs in the city means that, farmers come to the site at very different times. Good planning and coordination with important stakeholders would therefore essential for successful training which would enhance adoption.
The Tano South District Vegetable Farmers Society was identified as a good partner government or NGOs can liaise with to effectively train farmers on new strategies. The development of pest resistant varieties was one area the farmers identified can make a huge difference and drastically reduce their dependence on pesticides. They were of the view that, if they are rest assured that the seeds they have planted are resistant to pest attack, then they wouldn't worry too much when they see pests on the crops and immediately rush to spray. Some farmers even suggested that, genetic engineering should be employed to create vegetables which are resistant to insect pests. When their attention was drawn to the adverse effects of genetic engineering, one responded: 'We have heard that genetically engineered tomatoes are grown in Burkina Faso and the vegetables do not suffer pest attack like what we grow here. If there are adverse effects with growing genetically engineered vegetables, we are currently growing normal vegetables and its adverse effect is the pesticides we are talking about now. There are adverse effects with everything. We have not heard of any problems in Burkina Faso because of the tomatoes they are growing there'' (Agyei, vegetable farmer/Bechem).

The farmers' attention was however drawn to the fact that, the use of resistant varieties is part of IPM and so in combination with other strategies, they can effectively control the pests without their heavy reliance on pesticide. They were also reminded that the use of pesticide is also part of IPM but not the first and only choice to resort to when there are pest as they do now. I immediately realized a change in body language of most of the farmers when these were made known to them. For example, some of the farmers who hitherto seemed disinterested in the whole discussion on IPM were now asking questions about the role of chemical in IPM. The potential therefore exist to wean these farmers off the dependence on pesticides as their sole pest control measure. With the right education, training, technical support and policy environment, sustainable pest control strategy such as IPM can succeed here.

3.4 Pesticides

A total of 43 pesticides were found in use in vegetable farming in Ghana. This figure was obtained as a direct summation of pesticides applied on farms, but it could be lower than the actual number of pesticides in use. The pesticides comprised insecticides, fungicides and herbicides. Insecticide (44%) were the class of pesticides most used in vegetable farming in the areas surveyed, followed by herbicide (33%) and fungicides (23%). In Table 3.3 the classification of these pesticides by the type of pests they control, active ingredient, chemical group and WHO Hazard Category is presented. The herbicides and fungicides used are mostly under WHO Hazard Category III, with a few under Hazard Category II. All the insecticides used are under Hazard Category II, which WHO classifies as moderately hazardous. This category includes organochlorines (OCs), organophosphates (OPs) and Pyrethroids.

Table 3.3: Types of pesticides applied in vegetable production

Pesticide type (% of total number in use)	Active ingredient (AI)	Chemical group	Chemical AI Hazard Category (WHO)	Registered for use on
Herbicide (33%)	Pendimethalin	Dinitroaniline	III	Tomatoes, onions
	Glyphosate	Glycine derivative	III	Various crops
	Paraquat dichloride	Bipyridylium	II	Various crops
Fungicide (23%)	Mancozeb	Carbamate	III	Mangoes, vegetables
	Metalaxyl-M	Acylalanine	II	Not registered
Insecticide (44%)	Lambda-cyhalothrin	Pyrethroid	II	Vegetables
	Chlorpyrifos	Organophosphorus	II	Citrus, public health
	Dimethoate	Organophosphorus	II	Not registered
	Cypermethrin	Pyrethroid	II	Not registered

Source; field survey 2015.

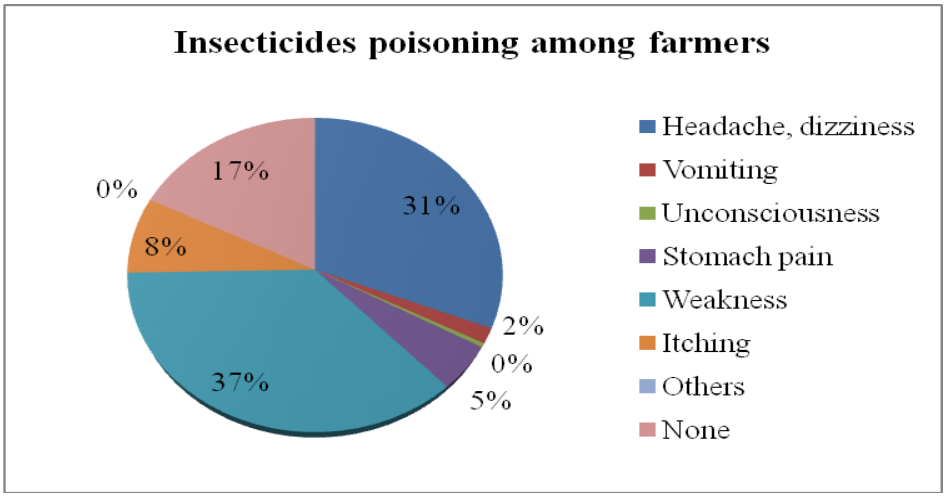
Table 3.4: Distribution of patterns of pesticide use and management in a sampling (N = 137) of vegetable farmers in Tano South District

Variable		Total Respondents	
A. Timing of Insecticide Application	Variable	Number Percent	Number Percent
	Presence of pests	99	39.9
	Degree of pest infestation	55	22.2
	Date of transplanting	67	27.0
	Others	27	10.9
	Total	248	100
B. Insecticide Handling Practices and Kinds of Protective Cover	Direction of spraying:		
	With the wind	90	65.7
	Against the wind	12	8.8
	Perpendicular	3	2.2
	Do not consider wind direction	32	23.3
	Total	137	100
	Pesticide label	74	27.5
	Agricultural Extension Officer	93	34.6
	News (Radio, TV, Newspaper)	21	7.8
	Fellow farmer	37	13.7
	Pesticide dealer	32	11.9
	Others	12	4.5
	Total	269	100
D. Farmer Re-entry Periods	Less than 48 h	99	73.3
	From 48 to 72 h	19	14.1
	More than 72 h	17	12.6
	Total	135	100
E. Insecticide Storage and Disposal	Safe storage practices	90	67.7
	Unsafe storage practices	43	32.3
	Total	133	100
F. Insecticide Poisoning Cases among Farmersa	Headache, dizziness	76	31.0
	Vomiting	4	1.6
	Unconsciousness	1	0.4
	Stomach pain	12	4.9
	Weakness	90	36.7
	Itching	19	7.8
	Others	0	0
	None	43	17.6
	Total	245	100
G. Disposal of empty insecticide bottles	Sell	0	0
	Throw away on farm	101	80.2

	Throw away in town or village	2	1.6
	Pile and sell	1	0.8
	Bury in ground in farm	22	17.5
	Burn on farm	0	0
	Total	126	100
H. Type of sprayer use and maintenance	Hand pump (Knapsack sprayer)	114	83.2
	Motorized sprayer	18	13.1
	By Hand	5	3.6
	Total	137	100

Multiple responses: total responses per item over total respondents; b Short trousers/short sleeves or T-shirt; short trousers/long sleeves; short sleeves or tee-shirt/long trousers; long trousers/long sleeves; Long trousers, long sleeves, mask and gloves

Figure 3.1



Within the vegetable farmer cohort there was an association between age and possible poisoning cases. The apparent association is not reasonably attributable to chance ($\chi 2$ = 13.5, N = 127, DF (degrees of freedom) = 6, P < 0.05). In Figure 3.1 we compare the distribution of possible pesticide poisoning cases between the young(<45 years) and the aged (>45 years). The percentage of farmers reporting body weakness and itching/irritation increased from the young group (39.1 and 6.3% respectively) to the aged group (41.3 and 12.7% respectively). A corresponding downward shift occurred in the percentage of farmers reporting headache/dizziness (i.e. a decrease from 34.4% for the young to 30.2% for the aged). Overall, possible poisoning cases were reported more among the young than the aged farmers. For instance, while about 6% of young farmers said they had not had any possible symptoms of pesticide poisoning, about 14% of the aged group said they had not.

Table 3.5: Spraying records of representative farmers at Tano South District

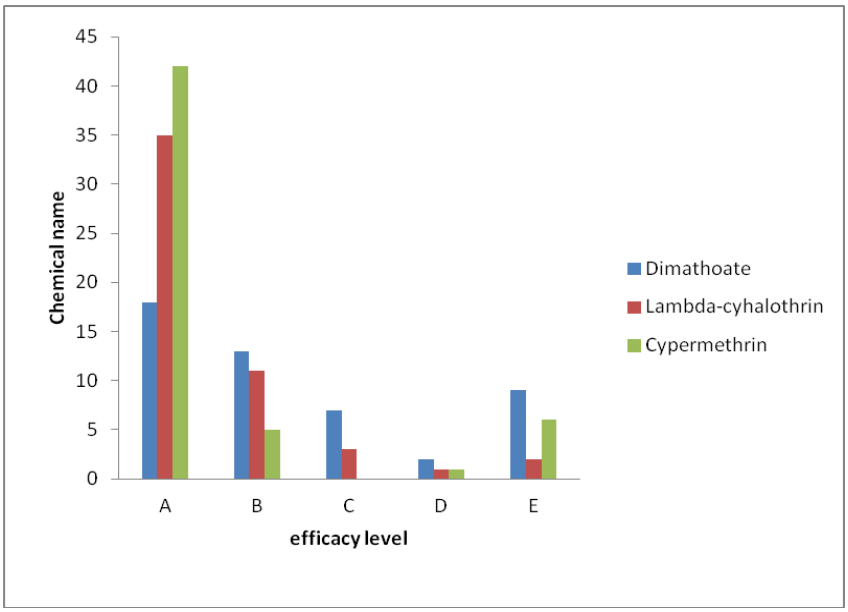
Case	Cropping months	Interval from planting to first spray (days)	Mean of spraying intervals (days)	Interval from last spray to harvest (days)	Number of sprays
1	Mar-May	7	7	7	12
2	Jul-Sep	21	7	34	6
3	Sep-Nov	14	7	13	10
4	Dec-Feb	14	7	14	9
5	Nov-Jan	14	14	11	6
Pepper	March	28	21	41	2
1	Sep-Dec	28	7	10	12
Egg-plant	Apr-Jul	28	7	7	12
1	Jul-Sep	14	7	40	6
2	Mar-May	14	7	13	10

Table 3.6: Vegetable farmers' perceptions of efficacy levels of three commonly known Insecticides

Chemical name	Efficacy level					Total responses	Average level
	A	B	C	D	E		
Dimathoate	18	13	7	2	9	49	2.4
Lambda-cyhalothrin	35	11	3	1	2	52	1.5
Cypermethrin	42	5	0	1	6	54	1.6

Levels: A = 75-100%; B = 50-75%; C = below 50%; D = not effective; E = causes more pest problems

Figure 3.2 Vegetable farmers' perceptions of efficacy levels of three commonly known Insecticides



When we assessed for significant interaction between method of pesticide application and farm size, we found a significant interaction ($\chi 2 = 46.6$, N = 137, DF = 6, $P < 0.001$). The distributions of the variables are presented in Figure 2.3. The majority of the farmers, laborers and their spouses ranked cypermethrin as the most effective pesticide against insects, followed by lambda-cyhalothrin and dimathoate in that order (Table 3.6). The average efficacy level for cypermethrin and lambda-cyhalothrin lay between levels A and B, i.e. providing more than 50 percent insect control. However, some respondents perceived an insecticide as ineffective or as causing more pest problems. Regarding hazard ranking, about 90% of the respondents who knew lambda cyhalothrin, 87% of those who knew cypermethrin and 84% of those who knew endosulfan ranked them level 1. No respondent considered lambda-cyhalothrin as harmless (Table 2.8). The average hazard level for all three chemicals lay between levels A and B, i.e. they were all considered extremely hazardous. The hypothesis that a respondent's perception of pesticide hazard is related to its perceived effectiveness against pests - that is, if it is strong enough to control pests, then it is hazardous - was tested. The results of the comparison between respondents' perceptions of pesticide effectiveness and hazard using the $\chi 2$ test do not support this hypothesis ($\chi 2 = 6.0$, DF = 4, $P < 0.05$).

4. DISCUSSION

4.1 Attitudes of rural-urban farmers towards the use or non-use of pesticides

The farmers have a positive attitude towards the use of pesticide to control pests though they are aware of the adverse effects of the chemicals. Chemical pesticides are regarded by the farmers as effective in controlling pests. When farmers see pests on the crops and spray, the chemicals get the job done by killing the insect pests. The farmers simply have confidence in it because it gives them results when they use it. Most of the farmers are hard press for time. They live far away from their farms, have other jobs or have to regularly travel out of the district to their hometowns for social activities such as funerals and festivals. Some even have their family living out of the city and so they have to shuttle

between Sunyani and where their families are located. They therefore find it not only convenient but also easy to simply spray and get rid of the pests destroying their crops.

Furthermore, the growing of exotic vegetables is relatively new to most farmers in the district even though most of them were farmers before migrating to the towns seeking better living conditions. The farmers therefore do not know the diseases and pests and invariably the control measures, including the pesticides, for these vegetables from their indigenous knowledge. Pesticides being readily available therefore become an easy solution to the farmers. In addition, the knowledge level of most of the vegetable farmers regarding pests, pesticides and crop protection in general is very limited.

Even though the acronym IPM is familiar to some of the farmers, they lack a detail understanding of the principles of IPM. Moreover, most of the farmers are of the view that, IPM is all about substituting chemical pesticide with bio-pesticide such as neem extract because of the manner in which they were introduced to the concept many years ago. There are very limited sources from where the farmers acquire knowledge about their farm operations in general and plant protection in particular. Most of the younger farmers at the study site said they obtained knowledge about farm practices from older/experienced farmers.

A survey carried out by Ackerson and Awuah (2010) found that, majority of the farmers applied pesticide weekly, whether insect pests were present or not, because that was what they perceived to be the right rate of application or the norm adopted from older/experienced farmers. According to the District Director of Agriculture, the Ministry of Agriculture through Farmer Field Schools (FFS) introduced the use of bio-pesticide (neem extract) Azadirachta indica as an alternative to chemical pesticides to vegetable farmers in the district in 1998. Farmers were also given some pest management training in the form of identification of different insect pests and the importance of beneficial insects to the control of pest. Apart from this, no other training regarding IPM has been given to the farmers in recent years. Consequently, most of the younger farmers have very little or no knowledge about alternatives to pesticide use.

Even though the farmers who were part of the training conceded that the bio-pesticide gave positive indications of controlling pest on the demonstration plots which were used for FFS, they did not fully adopt this innovation because not only was it very time consuming to extract the active ingredients from seeds and leaves of the neem plant, the efficacy of the extract to control pest in the dry season was very limited. The extra time burden required for the extraction of the bio-pesticide by time-constrained farmers together with the farmers 'perception of the ineffectiveness of the bio-pesticide especially in the dry season led to the initial low adoption rate and its abandonment by the few who adopted shortly afterwards. Even though it is clear that what the farmers were taught in the FFS was not IPM in its entirety no other significant effort has been made to train the farmers and help them to adopt the principles of other pest control measures including IPM. The District Director of Agriculture is overly optimistic about the prospects of farmers adopting IPM in the future. How can farmers adopt an innovation they don't fully understand and appreciate?

The farmers' desire to resort to pesticide to control pests therefore stems from the absence of alternatives. Lack of alternatives therefore makes pesticides the only viable choice for the farmers who live in an economic environment where they cannot afford to lose their harvest to pest damage

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Furthermore, there is neither a market for organically produced vegetables nor are there market standards to determine pesticide residue levels on harvested products. The priority of the farmers is therefore to protect their vegetables from pest attack by whatever means possible because they do not have any enforceable market standard in terms of pesticide residues to worry about after harvest. Minimizing economic risk is a major issue for vegetable farmers, especially those in developing countries like the Bechem farmers, because they have no opportunity for insuring themselves against risks such as harvest loss.

Reducing risk of harvest loss is a permanent driver of strategy adaptation as far as plant protection is concern so farmers are constantly evaluating the effectiveness of current pesticide vis-a-vis alternative strategies (L. Probst et al., 2012). The farmers perceive IPM (as they know it) to be risky and this is a contributory factor of their skepticism towards IPM. Although the district has attracted numerous intervention programmes from both local and international NGOs, none of these interventions has had IPM as its' main focus. Ironically, some of the interventions that have taken place at the site include pesticide trails by private agrochemical dealers (DPU, 2011). Farmers are operating in an environment where an effective, well-designed and well-targeted alternative ways of pest control is non-existent.

In spite of the numerous research that has confirmed the misuse of pesticide in urban agriculture (Fianko et al., 2011; W. J. Ntow, 2001; Tutu et al., 2011) as well as public awareness of the unacceptably high amounts of pesticides used in the production of their food (Bempah, Donkor, Yeboah, Dubey, & Osei-Fosu, 2011), very little has been done by both government and NGOs to wean the farmers off pesticides. At the same time, farmers face, on a daily basis, agrochemical input dealers, who are employing very aggressive marketing tactics including the use of the mass media such as advertising and promotion on radio and television, to sell their products to farmers.

IPM is often cited by policy makers as a strategy they are pursuing to reduce pesticide use but this is merely cosmetic because IPM is in fact much more than merely teaching farmers how to identify beneficial insects and the introduction of neem extracts to replace chemical pesticides. How can farmers effectively implement IPM when they have not been taught the rudiments and principles behind this pest control measure? How can there be an IPM without a comprehensive study of the pest ecology at specific production sites which would provide a good basis for the design and implementation of an effective IPM strategy?
It is obvious that more work needs to be done in order to put in place an IPM strategy that is effective to boost farmers' confidence in this control measure to facilitate adoption. In the absence of detailed knowledge about plant protection and lack of alternative crop protection strategies such as IPM that farmers deem effective enough to protect their crops from pest damage, spraying, and in most cases over-spraying, becomes the only viable option available to the farmers. The lack of effective alternatives has led the farmers to believe that, they cannot produce vegetables, under the prevailing pest pressure, without using pesticides.

The absence of market standards as well as the lack of capacity on the part of government agencies means that there is no testing for pesticide residues on vegetables in many developing countries before they reach the consumer. This situation has not only resulted in the alarmingly high levels of pesticide residues found on vegetables produced in urban areas (Bempah, Asomaning, & Boateng, 2012), but also serve as a disincentive for vegetable farmers to pursue other pest control strategies which often require more investment in time and knowledge through training.

Farmers are very much aware of consumers' concerns about high pesticide use but they have no motivation whatsoever to move away from the use of pesticides. Farmers can spray their crops as much as they want and there would be no consequences for the farmers. At the end of the day, getting an attractive product to the market is all that matters irrespective of the chemical residues on it because nobody checks it before it gets to the consumer. Furthermore, farmers are not held accountable for the environmental havoc they wreck by the indiscriminate use of pesticide. In the light of these, pesticide becomes an attractive choice for farmers when they encounter pest problem.

While there are stringent quality standards as well as labeling (with organically produced food selling at higher prices) of produce in place in many developed countries, this is not the case in many developing countries including Ghana. Consumers in Ghana judge the safety of vegetables on their appearance and consider vegetables to be safe based on freshness, cleanliness and being pleasant (vegetable without spots) to the eye (Acheampong, Braimah, Ankomah-Danso, & Mochiah, 2012).Vegetables, such as tomatoes, with attractive appearance, irrespective of the production method, are regarded as premium and attract higher price accordingly (Bempah et al., 2011).According to Acheampong et al.,(2012), 55.2% of consumers were not aware of safe/organic vegetables while majority of consumers were in no position to distinguish between organic vegetables and conventionally produced vegetables in the research they carried out in two major cities in Ghana. This situation makes it very difficult for many rural-urban vegetable farmers, including the Tano South District, to abandon the use of pesticide.

There is virtually no motivation to seek alternatives to pesticide use such as IPM because farmers are likely to adjust their production system only when this will result in increase in both returns to land and labour (Ruben, 2001). The use of pesticide is a "relatively easy" way of farming as compared to IPM. With many of the farmers at the district having other jobs apart from growing vegetables, spraying with pesticide to control pest saves them time for their other jobs. They would therefore not readily switch to other control strategies such as IPM which requires more time and planning if this would not result in any tangible economic benefit. With appearance as the benchmark for premium price, the farmers would not readily abandon the use of pesticides without the enforcement of market standards and other policies (or enforcement of already existing policies) by government.

4.2 Threats of Pesticide Use in Urban Agriculture

The district farmers mentioned general body pain and weakness, dizziness and difficulty in reading at night because of poor eye sight as some of the health issues they face which they attribute to pesticide use. Studies have shown that, exposure to pesticide leads to health problems such as dizziness, eye and respiratory problems, memory disorders, dermatological conditions and neurological defects (Ackerson & Awuah, 2010). Even though the farmers did not seem to worry too much about the health hazards they are exposed to by the pesticides because some deemed it as an "occupational hazard" while other were of the view that these were 'minor illnesses', the farmers can however be facing acute pesticide poisoning which can only be detected by body fluid analysis considering the intensity of pesticide use and the non-use of personal protective clothing. It is also possible that the farmers' assessments of the risks they face from pesticide exposure are either being downplayed or hyped. According Covello & Johnson (1987) risks are exaggerated or minimized according to social, cultural and moral acceptability of the underlying activities.

Another practice that has the tendency of exacerbating the issue of farmers being poisoned of pesticide is the fact that most of the farmers eat and drink from the site which is heavily contaminated with pesticides. Even though they seem not worried about this practice, it is a very easy was to ingest pesticides which can have devastating consequences on their health. Many of the farmers at the district did not use personal protective clothing even though they applied pesticide

regularly. Two main reasons were given as to why they did not use personal protective clothing; cost and discomfort. While it is true that these protective clothing cost money, farmers can easily improvise and get cheap clothing for protecting themselves if they really want to. For instance, some of the farmers we seen during the study spraying in T-shirts, shorts and slippers (see fig. 4) even though they can be in trousers and long sleeves shirts and shoes (cheap second-hand clothing are readily available) which can better protect them. This means that the farmers do not take the threats they face from the pesticides very seriously. They are aware these pesticides are toxic. Even though the farmers enumerated some symptoms which they attribute to the chemicals, these farmers do not take simple steps to protect themselves. Perhaps, they feel that skin irritation, body weakness and the other symptoms are no serious health problems. But considering the constant spraying these farmers are doing, it is very possible they are facing acute pesticide poisoning which may have a devastating effect on their health in the long-run. Farmers also cited discomfort in personal protective clothing especially overall clothing due to the high temperatures. One farmer had this to say when he was asked why he does not use personal protective clothing: "It is very uncomfortable to wear an overall and all those things (referring to goggles and respirators) while working in this hot weather. Apart from this, you look very ridiculous when you wear all those things when spraying" Kweku, Vegetable farmer/Techimantia).

It can be deduced from the farmer's response that, most of the vegetable farmers do not fully appreciate the health hazards of pesticide. A lot of awareness about the risks of pesticide use has been created by NGOs (Ackerson & Awuah, 2010) and so this behavior by the farmer can not to be attributed to ignorance. This careless attitude of the farmers with regards to protecting their own health means they are less likely to consider the effects of the pesticides on their consumers by spraying very close to harvest time and harvesting for the market. The combination of factors such as the limited knowledge/training of many of the farmers regarding the handling and use of pesticide, the absence of market standards regarding the residual levels of pesticides and other contaminants as well as farmers' seemingly carefree attitude towards the risks of pesticide seriously threaten the safety of vegetables that gets to consumers. The environmental hazards of pesticide use by farmers in the district emanate from pollution of the environment including surrounding water bodies as a result of run-off from the production site. Due to the high amount of pesticide used by the farmers, run-off from the production site is likely to contain excessive amount of persistent organic compounds which can be very harmful not only to aquatic life but also other organisms (both flora and fauna) in the surrounding environment.

Another source of environmental problem from the district is the indiscriminate disposal of pesticide sachets and containers. Empty sachets and containers are just dumped anywhere even though the farmers there is a designated spot at site where those containers are supposed to be dumped. Unfortunately, nothing is done to these empty pesticide containers when they are dumped there and the end up scattering all over the place. Sachets which are sometimes used to package some pesticides are easily blown away to far places by wind. The indiscriminate disposal of used sachets and containers is not only an eyesore but also a very dangerous practice which facilitate the export of pesticide residues beyond the boundaries of the District. Apart from the fact that these containers transport pesticide to non-targets sites, they make the environment unkempt and have the potential to reduce land value. Even though the farmers were not bothered about this indiscriminate disposal of used pesticide containers, nothing seems to be done by city authorities either as these containers were seen littered everywhere around the site.

4.3 Switching to Sustainable Pest Control Strategies.

The high and indiscriminate use of pesticide by Tano South Vegetable Farmers is not only dangerous to the health of the farmers and consumers; it is also bad for the environment. In order to reduce farmers' dependence on pesticides and switch to sustainable alternatives such as IPM, changes have to take place at two levels-the farm level and the policy level. However as things stand now, farmers have no incentives to switch from pesticide use voluntarily even though they expressed the desire to switch to alternatives pest control strategies if they find them effective. Policy initiatives, by state agencies, would therefore be the best approach to stimulate changes in farmers' behavior which can facilitate the adoption of sustainable strategies.

In the first place, government must introduce and enforce market standard for all foods especially vegetables in the Ghanaian market. There are already state agencies such as the Food and Drugs Board and Ghana Standard Board which can be tasked to enforce these standards. It is important to note that, for this policy to trigger the desire response at the farm level, mass education especially by using radio and TV should be done. Market women who are usually the retailers of vegetables should also be engaged and educated about the dangers of high pesticide residues and how checks would be conducted on the vegetables they are selling in the market at random. If traders selling vegetables which are found to contain high pesticide residues are sanctioned, they will buy only from farmers who use less pesticide and this can stimulate changes in farmers' attitude and behavior towards the use of pesticides.

In addition, state agencies in collaboration with NGOs should start a serious campaign to promote organic vegetables in the country by once again employing mass media platforms such as radio and TV. There is currently no market for organic produce and this doesn't motivate farmers to abandon the easy way of just controlling pest by spraying.

Highlighting the advantages of organic vegetables would not only create a market for it, it would also expose the dangers of pesticide use to the public which can trigger changes in farmers' behavior at the farm level. At the farmer level, farmers have already expressed their desire to adopt sustainable pest control strategies. A number of things, in the view of the farmers, need to be done to help them not only to reduce their over-dependence on pesticide but also facilitate their adoption of other pest control strategies such as IPM in the long run.

Research to underpin the design of a comprehensive and effective IPM was identified by the farmers as crucial if they can manage pest in a safe and sustainable way. According to them, the prevailing economic climate in the country means that losing their crops to pest would have a devastating effect on their livelihoods due to the absence of socioeconomic safety nets. Alternative strategies, they say, must be effective in controlling the pests in order to facilitate adoption. It is therefore very crucial for a thorough research to be done at 'local sites' to provide a basis for the development of effective IPM which to enhance its' adoption by farmers. Training of farmers on alternative strategies such as IPM was also identified as very crucial if farmers are to abandon their reliance on pesticides.

The District Vegetable Farmers Society was identified as an important stakeholder that can effectively coordinate a training programme to ensure that more farmers adopt IPM when an effective one is introduced. The breeding of resistant varieties was one area the farmers wanted more research to be carried out. They were of the view that, the vegetables they grow are very susceptible to insect pest attack which results in the application of excessive amounts of pesticide and hence if they can get varieties which are resistant, pesticide use would be reduced drastically. Some farmers suggested that government and scientist should employ genetic engineering to create seeds which are pest resistant and that, they would welcome Genetically Modified Crops (GMOs) if that would help them reduce their dependence on pesticide. Even though they had very little information about the adverse effects of GMOs, they were aware that genetically engineered tomatoes have been introduced in a neighboring country and they felt this should also be done in Ghana to tackle the pest problems they face. It is however worth to mention that, public education on GM foods is very scanty and there is a general lack of in-depth understanding of what GM foods are among the ordinary citizenry (Buah, 2011)

5. CONCLUSION AND RECOMMENDATION

The issue of insect pest is a serious challenge to vegetable farmers at Tano South District. To protect their crops and invariably their livelihoods, these farmers depend mainly on chemical pesticides to combat the insect pest menace because they feel this is the only effective way to control the insect pests. Their choice of pesticide over other pest control strategies is due to the lack of knowledge and training on sustainable alternatives such as IPM. Very little has been done by the MoFA and other government agencies to implement effective strategies that will help farmers reduce their dependence on pesticides.

The use of pesticide poses serious threats to farmers, consumers and the environment. Controlling pest by using pesticides has created health issues for the farmers mainly due to improper handling of pesticides as well as the non-use of personal protective clothing.

The indiscriminate disposal of pesticide containers also has serious environmental implications. Apart from the hazards of pesticide use on farmers and the environment, consumers also face huge health risk by consuming vegetables with high pesticide residues. Even though pesticides use is the main pest control strategy currently employed by the farmers, they are ready to adopt other sustainable approaches such as IPM to reduce their dependence on chemicals. However, in order to ensure high adoption rate of sustainable pest control strategies such as IPM, it should be part of a broader policy strategy.

Furthermore, government needs to invest in research in order to come out with a sustainable pest control strategy that is effective. Proper training of farmers is also required for any alternative pest control strategy to succeed because farmers will only adopt if they are convinced that it would work. The study has identified that, farmers are willing to switch to other sustainable pest control strategies such as IPM. However, such a switch can only happen when farmer are sure that alternative control strategies are effective in controlling pest. It is therefore recommended that, a thorough study of the pest ecology is done at the district to get a deeper and better understanding of the pest situation. This would provide vital information for the development of an effective IPM.

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