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Original Research Paper

A survey of some critical issues in vegetable crops farming along River Oyansia in Opeibea and Dzorwulu, Accra-Ghana

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Crop farmers along the Oyansia River in the Opeibea and Dzorwulu Communities, Accra use pesticides to control pest infestation which has been a cause of recurring loss of productivity. This study was conducted to assess the knowledge of pesticides handling by crop farmers along River Oyansia through questionnaire interview with forty (40) out of the sixty-eight (68) cabbage farmers identified. The study revealed heavy reliance of pesticides for insect pest control. Male farmers (77.5%), the most susceptible to pesticide effect, dominated crop farmers probably due to cultural factors. Also younger people (18-35 years) formed majority of farmers pointing to the propensity to undertake this strength-driven activities. While this may on one hand indicate reduction in unemployment, the low level of educational attainment (basic education) by majority (55%) of farmers seems to heighten disregard for human health safety measures including wearing of protective devices (e. g. nose mask) and sound environmental safety practices measures (e. g. proper disposal of pesticides containers) which in turn promote susceptibility to health disorders and pollution of the river during runoff respectively. Although farmers were aware of the banned pesticides by the Ghana EPA, weak understanding of the human and environmental health safety reasons behind the ban or weak enforcement or both might have encouraged the continuous abuse of these pesticides.

Keywords: pesticides, vegetable crops, health, knowledge

INTRODUCTION

The food and agricultural industry plays a major role in Ghana's economy. Agriculture is a source of livelihood to individuals who are engaged in it right from cultivation to the final consumer (Sinnadurai, 1992). Vegetable cultivation provides an excellent source of employment for both rural and urban dwellers as it is grown in many rural areas through truck farming and in the outskirts of towns and cities as market gardening and backyard gardening to be supplied fresh to the urban markets. According to the Ghana Export promotion council (GIPC), from 1990 to 1999, the agricultural sector contributed an average of 41.3% to gross domestic product and 12.2% of national tax revenue. These may suggest that the livelihood of the average Ghanaian depends either on agriculture or agriculture-related business. Some farmers in Ghana, in a desperate attempt to protect their crops spray on them banned hazardous pesticides including organochlorine (e. g. dichlorodiphenyl trichloroethane

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Table 1 Types of agrochemicals used in Ghana

Agrochemical type	Active Ingredient and concentration	WHO/FAO Hazard Class
Insecticides	Lambda cyhalothrin 2.5%	II
	Fipronil 25g/l	II
	Dimethoate 400g/l	II
	Cypermethrin 10g/l	II
	Azadirachtin	U
	Bacillus thuringiensis 2.86%	IV
	Deltamethrin 25.5g/l	II
	Fenvalerate 20%	II
	Chlorpyrifos-ethyl 480g/l	II
	Acetamiprid 25g/l	IV
Fungicides	Copper hydroxide 77%	II
	Mancozeb 800g/kg	III
	Maneb 800g/kg	III
	Metalaxyl-M, (6%) + Cuprous oxide (60%)	III
	Carbendazim 500g/l	III
Herbicide	Pendimethalin 400g/l	III
	Glyphosate 41%	III
	Paraquat 200g/l	II
	2, 4-D Amine Salts 720g/l	II
	Atrazine 80g/kg	III
	Atrazine 500g/l	III
	Diuron 56%	II
	Bromacil 24%	II

(DDT), cyclodienes and hexachlorocyclohexane) and organophosphates such as methyl organophosphate (azinphos-methyl, phosmet and malathion) methyl parathion or parathion-ethyl, dursban (chlorpyrifos) and tetraethyl pyrophosphate. It is reported by the World Health Organization (WHO) that 20% of pesticide use in the world is concentrated in developing countries posing danger to human health as well as the environment (Hurtig *et al*., 2003). Families residing in agricultural areas have been found to have noticeable levels of pesticides in their body systems (McCauley *et al*., 2001). These have been higher in homes that are located closer to fields (Quandt *et al*., 2004). These pesticides are widely used by farmers to control pests because of their effectiveness and their broad-spectrum and are applied at different application rates and frequencies (Brempong-Yeboah, 1992). They are perceived to pose difficulty to degrade under environmental conditions. In addition, they are toxic, persistent, bioaccumulating, carcinogenic, mutagenic and teratogenic. Organochlorine interaction with the endocrine system, results in numerous biological effects on humans and animals.

Crop farmers along the Oyansia River in the Opeibea and Dzorwulu Communities appear not to observe any human and environmental safety regulations associated with handling and use of pesticides. For instance it is doubtful whether farmers follow the recommended mixing ratios of these pesticides to water and also whether they apply them at the recommended doses and regimes (or frequencies). Again their observance of the pre-harvest spraying time interval and proper disposal of agrochemical wastes, washouts, and empty containers are questionable. Intensively managed vegetable farms are also characterized by an extensive network of drainage systems where surplus water may flow into local streams and rivers. Environmentally, runoff of agrochemicals may contaminate water bodies to exert their toxicological effect. Excessive use of persisting pesticides in the fields causes surface and underground water contaminations. This has been illustrated by records of some international studies. They cause, soil and water contaminations. Once released into the environment, pesticides tend to build up in the fatty tissues of living organisms, causing serious harm to the health of species and a potential loss of bio-diversity. Methyl bromide, one of the mostly used pesticides for soil fumigation in many countries has been identified as the major contributor of ozone depletion (Giri, 1998). They usually reach aquatic ecosystems through erosion and runoff from agricultural and contaminated land, atmospheric deposition, and discharging of effluents from factories and sewage (Beitz *et al*., 1994). Their lipophillic nature causes them to concentrate in the tissue of exposed organisms (Smith and Gangolli, 2002). Equally important, factors like low solubility and high soil adsorption coefficients cause pesticides to persist in the environment for years after their initial entry (Barbash *et al*., 1996; Pan and Liang, 2008). Ecologically, non-target flora and fauna concentrate residual agrochemicals in their tissues and pass them on along the food chain (Koomson, 2012). Lack of attention and due care of proper handling and use of pesticides by vegetable

farmers could lead to build-up of pesticide residues beyond acceptable limits in the soils and hence the crops and also contaminate River Oyansia through run-off.

It is desired that harmonious anthropogenic interaction with the aquatic environment be promoted. The real and prevailing situation and the causes of environmental degradation have to be known and understood for effective measures aimed at prescribing the appropriate remedial action to be designed. Thus, an important means of achieving this is acquisition of knowledge of the current state of the interaction, which presents the first hurdle to leap. This enables the needed sustainable remedial action which may range between short and long terms to be prescribed. There is the need for serious scientific attention in terms of investigation to ascertain the perceptions of farmers on the issue concerning pesticides and their uses.

METHODOLOGY

The Study Area

Most of the farm lands in Accra, the capital city of Ghana are used for the cultivation of food crops like corn, okro, tomatoes, cabbage and other vegetables. Inhabitants of Accra, consume crops cultivated along rivers and streams in the city and sold on the markets. Two communities, Opeibea and Dzorwulu in the Greater Accra Region of Ghana through which the Oyansia River passes were selected for the study. The selection of these communities was based on high concentration of vegetable farms (sixty-eight) along this stretch of the river. There are some drains to enable quick discharge of storm waters. There are three broad vegetation zones in the Accra Metropolitan area; namely shrub land, grassland and coastal lands. Loss of trees is one of the principal reasons for the severity of erosion in some areas that occurs during rainfall. Fertilizers and insecticides are heavily used in these areas. Constant felling of trees, unapproved farming practices and indiscriminate burning have altered the vegetation and greatly depleted the fertility of the soil. The rainy (two periods) and dry seasons affect crop production in these communities. There is very little variation in temperature throughout the year. Due to Accra's location (i. e. adjacent to the ocean, temperature is fairly stable from 24.7^{o}C in August, which is the coldest to 28°C in March, the hottest with an annual average of 26.8°C. The soils are of the drift materials, alluvial and marine motted, residual clays and gravels and lateritic sandy clay soils characteristics.

Data Collection and analysis

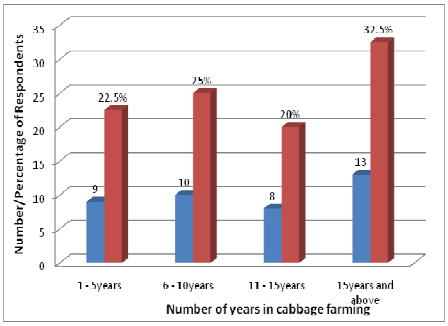
A reconnaissance survey was conducted to get familiarized with the study site and to aid in the mobilization of needed logistics and resources and also to validate the information gathered from literature search. Potential respondents who were vegetable crop farmers mainly cabbage farmers in Opeibea and Dzorwulu communities cited along the Oyansia River were identified. They were made up of both males and females. The goal of the study was explained to these respondents to seek their consent. This was done in order to ensure their cooperation, which was very important for the study. A study tool, structured questionnaire which was composed of open-ended and close-ended questions developed to solicit information concerning farmers' knowledge of handling and use of pesticides and their effects on humans and the aquatic environment was administered to the consented respondents. Out of the sixty eight (68) vegetable farmer respondents, forty (40) were randomly selected for the study. The questionnaire covered the following areas: demographic characteristics of farmers including age, gender and educational attainment; type of vegetable crop cultivated; regimes and frequency of pesticide application, and general basic knowledge concerning the categories of pesticides (banned and permitted categories) and general handling practices including precautions such as wearing of protective cloths and other devises such as nose masks and gloves and methods of disposal of pesticides containers, .

A checklist was also kept to ensure that all questions related to all sections of the questionnaire were responded to. The data generated was classified and expressed as frequencies using the Statistical Package for Social Sciences (SPSS), version 11. Consistencies in data were re-checked as a quality control measure. Cases of missing values were not included in the analysis. The responses were first summarized over all populations; frequencies for the populations were calculated. Mean of parameters considered were calculated.

RESULTS AND DISCUSSIONS

Demographic characteristics of cabbage farmers

These *characteristics* were to help ascertain the suitability of respondent for the research. Age and gender, for instance are of critical importance in resource exploitation and perception studies. The effects of pesticides have been found to vary according to demographic parameters including age, gender and education (Anger *et al.* 1997). Results showed that thirty-one of respondents (77.5%) were males while 9 (22.5%) were females. This variation may be promoted by culture of the communities that enjoins males to assume headship of families and therefore hold in trust assets of families including agricultural lands. This observation



Figire 1 Distribution of farming experience of cabbage farmers along the Oyansia Stream

corroborates that by Masterson (2007) who noted that in many parts of the world women have the least probability of owning land. Also in the case of rented land, males usually fronted or initiate negotiations as observed in this study.

Although the causes of the differential effects of pesticides on gender has not been established, significant effect on farm workers, with males being the most affected, has been reported by (Kasner, *et al.*, 2012). This may probably be due to biological traits and the associated differential abilities to metabolize pesticides (Furlong, 2000). Males undertake mixing during pesticides application and therefore are in direct contact with pesticides than females. Levin *et al.* (2002) observed differential effects of organophosphate in rats of different sexes. Given the high strength-driven requirement of crop farming activities and the background high vulnerability of males to effect of pesticide, the males who form majority of farmers observed in this study, the possibility of decrease in productivity cannot be ruled out unless the appropriate practices are adopted to hold it in check.

Majority (45%) of the farmers were between the ages in the range 18-35 years and a mean of 30 years while 35% of them were of ages ranging between 36 and 45 years with an average age of 41 years and eight (20%) above 45 years. Twenty-four (60%) of farmers were married while sixteen (40%) of them were single. The involvement of younger people, who are known to exhibit the propensity to undertake strength-driven activities, may suggest reduction in unemployment, if all other factors constant are held constant.

Choice, motivation and source of pesticides

All the farmers interviewed noted that they encounter problems with insect pests. Pesticides like deltamethrin and imidacloprid and fungicides like mancozeb and maneb were used to control pests in the cabbage farms. Farmers also used herbicides to control the growth of unwanted weeds in the farms. The choice of these pesticides was guided by effectiveness in controlling pests. Pesticides were purchased at the beginning of the growing season and after the appearance of pests. Pesticides were purchased from chemical retail shops and normally stored in the farm before use. Information on factors that motivate farmers to choose particular pesticide serve as important guide to authorities (environmental managers and policy makers) on the types of pesticides that are likely to be available on the market and the likely channels of distribution. All farmers applied pesticides but at varying extents.

Length of stay in farming and the perceived associated experience were major factor of concern. Farmers have been in farming for at least five (5) years (Figure 1). Farmers, with longer stay in the farming business, held the view that as land loses its fertility due to continuous cultivation, higher concentration of fertilizers and pesticides and higher frequency of application are directly linked to increase in productivity. Farmers considered disregard of this view as less risk-aversion, although its implementation is at the expense of the health of humans and the environment. This is in line with an assertion by Ajewole (2010) that with a greater number of years of experience, a farmer becomes more risk-averse when judging new technology but at variance with Liu and Huang (2012) that cotton farmers behave in a loss averse manner in the health domain and place more weight on the importance of health over money in the loss domain.

Pesticides were readily obtained from agricultural retail shops. Pesticide dealers took advantage of farmers' inability to raise enough funds to purchase expensive but suitable pesticides and therefore sold (sometimes on credit) all kinds of products to them irrespective of their suitability and effectiveness at controlling the various designated pests. Farmers sprayed the same wide range of insecticides on wide range of crops. Again, some information on pesticide label were deceptive. For instance, cabbage farmers sprayed their crops with insecticides such as Acetamiprid 20g/l (Cocoprid 20 SL) which is registered by the Ghana EPA as an insecticide for the control of caspid bugs in cocoa due to its toxicity and persistence. This has serious public health implications.

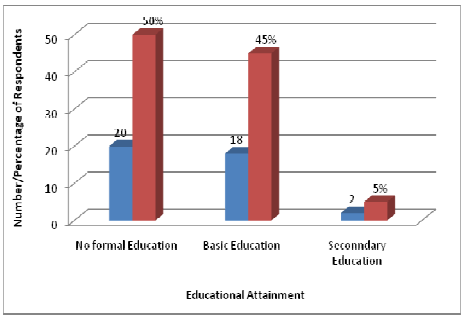


Figure 2 Distribution of Educational Level of Cabbage Farmers

Table 2 Protective clothing used during pesticide application

Protective clothing	?% of total no. in use
Long Sleeve Shirt	80
Long Trousers	52
Wellington Boot	30
Gloves	40
Respirator	0
Nose Mask	40

Knowledge of pesticide and their direction of use

Farmers were mostly (91%) small scale farmers. The cabbage farm land ownership scheme in the area was mainly of the leasehold type and farmers sometimes cultivated cabbage with other vegetables depending on which vegetable was patronized most at a particular time. The manner in which a pesticide product is used is likely to be driven by the extent of knowledge an individual has on the product (Leonard and Wogalter, 2000) and good knowledge may be linked to the level of educational attainment. Farmers with good pesticide knowledge were more inclined to use pesticides according to the recommended guidelines. Fifty percent (50%) of the farmers had formal education. This consisted of basic education (45%) and secondary education (5%) but no tertiary education (Figure 2).

This generally suggested that there is less likelihood of efficient farming and is in agreement with Weir (1999) who observed that education may enhance productivity by improving quality of labour, increase ability to adjust to disequilibrium and propensity to successfully adopt innovations. Results showed that although farmers were aware of the banned chemicals and the human and environmental health safety reasons for the ban, weak enforcement of the ban encouraged their continued use. Majority (75%) of respondents did not observe any health safety measures whiles the remaining 25% observed health and safety measures by wearing protective clothing. The types of protective clothing used by farmers during pesticide application included gloves, wellington boots, nose masks and long-sleeved shirts (80%) and (52%) trousers (Table 2). Low level of education seems to promote risk of pesticide abuse. This may possibly be attributed to difficulties in understanding or disregard of use instructions and safety procedures on the product labels.

Majority of farmers (85%) disposed off emptied agrochemical containers by the following means: by burning them on the farm, leaving them on the farm land (without any knowledge of pesticides chemistry), by digging up the soil and burying the containers (without any knowledge of the hydrological characteristics of the area of which the farm forms a part) or by placing them in the communities' waste bins. Proximity of the rivers and other waterways to the cultivated farms as in the case of cabbage farms in the survey area (along the Oyansia stream), could also have been taken by farmers as a convenient means for disposal of unwanted insecticide solutions and emptied containers. These methods of disposal pose varying degrees of health risk to both humans and the environment as noted by (Recena *et al*., 2006) and may affirm the exhibition of poor knowledge of issues relating to pesticides as observed in the study. It presents potential pollution problems for aquatic systems in the surrounding areas which are sources of livelihood for human communities and also support a variety of plant and animal life that sustain the ecology.

Majority (67.50%) of the farmers sprayed pesticides on their crops without considering the direction of the wind while minority (32.50%) considered this, applying the pesticides in the same direction as the wind. Fifteen percent (15%) of respondents re-used emptied pesticide containers for holding, storing or fetching pesticide solution and also as irrigation cups, practices that contradicts the recommendation by the WHO. In addition to these, farmers applied combinations or mixtures of insecticides. This practice of combining insecticides

Plate 1: Application of pesticide on cabbage crop by a farmer along the Oyansia River

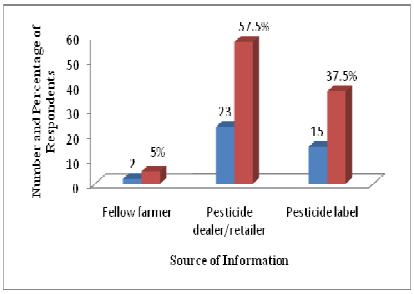


Figure 3. Distribution of Farmers' Source of Information on Pesticide Application

before spraying may be promoted by farmers' perception and desire to have a rapid knockdown of a broad spectrum of pests. The implication of the practice is that there is the possibility of the inefficacy of some of these pesticides of the mixture masking the efficacy of the others. Moreover, the possibility that the practice might have contributed to the increased incidence of insect pest resistance which in turn advances the incidence of pest infestation of crops cannot be dismissed from consideration (Metcalf, 1980 and Biney, 2002).

Water from the stream was used by majority (85%) of farmers for crops irrigation whiles 15% of the farmers depended on waste water from nearby factories. All the respondents washed their spraying equipment after use with water. Fifty-two and a half percent (52.5%) of respondents disposed the waste water on crops and weeds whiles 47.5% disposed the water on the field. Thirty-five percent (35%) of farmers calibrated their equipment while 65% did not. Majority (80%) of farmers applied pesticides themselves (Plate 1) while 15% relied on their children some of whom were of the school-going age and sometimes on hired labour. Although in one way, children's assistance could be beneficial, the associated effect on some aspects of their life including their health and education could offset any such benefits. Also advancement of the practice into child labour cannot be ruled out. Incidence of enslaved children has been a report in some crop production areas in West Africa (Raghavan and Chatterjee, 2001)

Ninety three percent (93%) of farmers observed a pre-harvest interval, after the last insecticide application normally of 1-2 weeks interval. However, 7.5% of the farmers in the study did not observe pre-harvest interval. Majority of the farmers interviewed did not keep farm records on insecticide use. The prevalence of these methods and practiced may be rooted in low educational attainment which is reflected in poor level of knowledge of issues relating to pesticides.

Majority (57.5%) of the farmers obtained information on pesticide application from pesticide dealers or retailers with 37.5% of them following instruction on pesticide labels. Five percent (5%) of them obtained information from fellow farmers (Figure 3). This suggests that designing and implementing educational programmes at the sale points are likely to make huge contribution to prevention of pesticides abuse.

In the cabbage ecosystem, the insects that the farmers attributed destruction of their crop to were the larvae of *Plutella xylostella* and *Spodoptera littoralis*. Other insects implicated in the study were *Brevicoryne brassicae* and *Zonocerus variegatus*. Brempong-Yeboah (1992) and Ninsin (1997) observed that *P. xylostella* is a pest of cabbage in the Accra plains of Ghana. Farmers noted that the diamondback moth could be so damaging that they completely destroy their crops. The larvae stage of this insect is damaging. It causes damage by feeding on the underside of the leaves, making holes right through them (Hill, 1993). The damage caused by *B. brassicae* was not quite obvious on the farms despite the presence of aphids on the cabbage crop. Growers also remarked that the pest status of aphids was next to that of the diamondback moth. Ninsin (1997) also observed that aphids cause stunted growth and isolated wilting of cabbage plants. These aphids have been implicated as vector of 23 viral diseases in Crucifers (Hill and Waller, 1990). The larvae of *S. littoralis*, also cause extensive damage to cabbage leaves. Z. *variegatus* a sporadic sever pest of many crops (Hill and Waller, 1994) chewed cabbage leaves, leaving characteristic ragged edges or completely defoliated plant.

These insect pests and diseases pose big problems in horticultural production. The damage caused by them has led to farmers who rely on these insecticides for cultivation of the crops (Ntow *et al*., 2006). Dinham (2003) recounted that an estimated proportion of over three-quarters (87%) of farmers in Ghana apply a variety of chemical pesticides to control pests and diseases during cultivation of their crops. In fact chemicals are used extensively on horticultural farms, small or large and farmers use a wide range of herbicides, fungicides and insecticides. In the survey the main method of weed control were identified as manual weeding with hoe and cutlass, and the use of herbicides. Farmers held the perception that herbicides have the ability to effectively suppress for a longer time and over a wider area, weeds that account for lose of productivity that has been occurring during the production cycles. These pesticides were considered to offer a greater advantage over manual weeding with hoe and cutlass. This formed the bases for their heavy reliance on pesticides.

CONCLUSION

The study revealed that cabbage farmers in communities along the Oyansia Stream of Accra, Ghana seemed to be unaware of real pesticide risks and therefore underestimated their potential human and environmental health risks. This is reflected in the continuous use of banned pesticides, disregard for adequate protection during handling of pesticides. Label instructions and hygiene practices such as washing of cloths and hand washing immediately after application as well prohibitive acts such as eating, drinking, smoking during the application of pesticides were also not adhered to. This underscored the need for intensified pesticide management education in the communities. Again, the study confirms the general perception that good level of education and hence knowledge are associated with safe use of pesticides among farm workers. Farmers' perceptions and beliefs about pesticides have obscured the importance of preventive and precautionary measures for protecting themselves from health hazards associated with pesticides and their wrongful handling or abuse. A very helpful and effective means of addressing the issue is a call for intensified education and public awareness creation, continuous monitoring and enforcement of laws concerning the use of pesticides, although the latter has usually not been without challenges as a result of lack of the political will which ought to make way for safe human and environmental health.

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