



Perceptions and Practices of Herbicide Use among Peri Urban Vegetable Farmers in Selected Hubs of the Accra Plains

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Authors' contributions

This work was carried out in collaboration between all authors. Author ESKO performed the descriptive analysis and wrote the first draft of the manuscript. Author SY helped in the data collection in the field. Author FA helped in the data collection and entry. Author JS helped in the data collection. Author EOA read through the manuscript. Author MO designed the study and read through the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To assess the knowledge base of farmers regarding herbicide use and secondly determine the attitudes and practices of herbicide use among peri urban vegetable farmers.

Study Design: The study design is by survey and collation of questionnaire in selected urban areas noted for vegetable productions.

Place and Duration of Study: The study was conducted at Ashaiman (5°40'41.42"N, 0° 2'15.27"E) under Ashaiman Municipality, Dzorwulu (5.6116°N, 0.2034°W) under Ayawaso West district and Borhye (05.67682°N, 000.21194°W) under Ga East district of the Greater Accra Region of Ghana. These areas are major vegetable production hubs in Greater Accra Region of Ghana. The study was conducted between July and August 2015.

Methodology: A questionnaire consisting of structured items was designed. Data was collected through a farm survey by face to face interviews with farmers during farm activities. Structured interview schedule with both open ended- and closed ended- questions was prepared and

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administered. The questions were written in English and response was elicited both in English and respondent's lingua franca (Akan) of each of the survey community. A total of twenty (20) questionnaires were administered and the same number was returned. The site was selected based on the crops grown, herbicide usage.

Results: The herbicides used were Round up with Glyphosate ammonium as active ingredients, Kwatriqua with Paraquat as active ingredient. Majority of the farmers observed precautionary measures such as wearing boots, overall and nose masks when applying the herbicides. All the farmers agreed to using herbicides in the land preparation of their farms. About 70% of the farmers makes 20% economic returns after herbicide applications. Equal numbers of the farmers use contact and selective herbicides in spraying their farms. Farmers select herbicides based on their quick action and effectiveness in killing the weeds.

Conclusion: The perceptions and practices of the farmers on herbicide use still need to be improved, their attitude is also still negative. Government should in no time discourage the use of herbicides that have been banned by WHO and FAO. Government should educate farmers on Integrated Pest Management thereby reducing health hazards posed by herbicide usage. The indiscriminate use of herbicides, often in excess. Evaluations such as these, guidelines to users and clarifications to the population should be encouraged.

Keywords: Survey; health; organisms; crop; pests; Ghana.

1. INTRODUCTION

Vegetables are important crops in most parts of the world. In Ghana, vegetables are indispensable ingredients in the daily diets of people across all regions. Vegetable production is an excellent source of employment for most rural and urban dwellers. Production of vegetables in urban communities is mainly in the form of market and backyard gardening to supply fresh produce to urban markets. The vegetables most commonly grown in Ghana are: tomato (*Lycopersicon esculentum* L.), onion (*Allium cepa* L.), shallots (*Allium escalonicum* L.), okra (*Hibiscus esculentus* L.), eggplant (*Solanum melongena* L.), local spinach (*Amaranthus* spp), Indian or Gambian spinach (*Basella alba* L.), sweet and chilli pepper (*Capsicum annuum* L.), and hot pepper (*C. frutescens* L.).

Vegetables are generally susceptible to a wide range of pests and diseases, these are major constraints to vegetable production in Ghana and require intensive effort in their management Ntow et al. [1]. The increased demand for food, particularly to feed the growing urban population in Ghana, has necessitated an expansion and intensification of agriculture and horticulture and a concomitant increase in the use of synthetic pesticides for food production Amoah et al. [2], particularly for the production of high-value cash crops and vegetables [3].

Dinham [4] estimates that 87% of farmers in Ghana use chemical pesticides to control pests and diseases on vegetables and fruits. Ntow et al. [1] gave the proportions of pesticides used

popularly on vegetable farms as herbicides (44%). The amount of herbicides imported into Ghana from 2002 to 2006 increased from 2,186 metric tonnes to 10,718 metric tonnes [5]. In a work done by Nonga et al. [6], the herbicide commonly used in the treatment of weed in Tanzania include Glyphosate isopropyl ammonium (Kalachi®), isopropyl amine salt of glyphosate (Round up®) and 2, 4-dichlorophenoxy acetic acid (Balton®) (2, 4-D Amine). Similarly, in Ghana, Afari-Sefa et al. [7] listed 9 different herbicides used on vegetable farms in Western and Ashanti regions of Ghana. These include Glyphosate (Adwumapa, Adwumawura, Round up, Sunphosate, Weed out), Condemn, Atrazine (Agrazine), Paraquat dichloride (Gramoquat, Gramozone).

Herbicides have posed a number of problems for agriculture, including the killing of beneficial insects, secondary pest outbreak, the development of resistant pests, health problems for farmers that handle the chemicals such as abdominal pain, dizziness, headache, nausea, vomiting as well as skin and eye problems [8]. Another impact of pesticides and herbicides on living organisms have been the widespread development of resistance in which some insects and weeds are no longer killed by the chemicals at the prescribed dosage formally found to be lethal [9].

A survey carried out by Afari-Sefa et al. [7] on 437 farmers in Ashanti and Western Regions of Ghana found that farmers are misapplying pesticides by disregarding the potential harmful effects of pesticides on human health and the

environment. It is evident that Ghanaian public and government are becoming increasingly aware about excessive use of chemical pesticides by vegetable farmers. Therefore, this trend should be reversed if agricultural production is to be safe and sustainable in the future [10]. In addition, most Ghanaian populace are particular about amount of herbicide applied on the vegetable farms and their impact on the environment and the natural resources therein. Little scientific work has been done to ascertain the quantity, characterize the impact of herbicide use on peri urban vegetable farms in Ghana. It is therefore prudent to carry out this study to first of all determine the knowledge base of farmers regarding herbicide use and secondly determine the attitudes and practices of herbicide use among peri urban vegetable farmers.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted at Ashaiman (5°40'41.42"N, 0°2'15.27"E) under Ashaiman Municipality, Dzorwulu (5.6116°N, 0.2034°W) under Ayawaso West district and Borhye (05.67682°N, 000.21194°W) under Ga East district of the Greater Accra Region of Ghana. These areas are major vegetable production hubs in Greater Accra Region of Ghana.

2.2 Data Collection

A questionnaire consisting of structured items was designed. Data was collected through a farm survey by face to face interviews with farmers during farm activities. Structured interview schedule with both open ended- and closed ended- questions was prepared and administered. The questions were written in English and response was elicited both in English and respondent's lingua franca (Akan) of each of the survey community. A total of twenty (20) questionnaires were administered and the same number was returned. The site was selected based on the crops grown, herbicide usage. Data were recorded between July and August, 2015 by the investigators, who are scientist with long experience in pesticide related research. The one-on-one survey instrument comprised of three categories of questions based on (i) biodata (i.e., age, gender, educational background, work experience), (ii) herbicide knowledge (i.e types of herbicide used, training on herbicide use, soil dwelling organisms

observed before herbicide application, soil dwelling organisms dead after herbicide application, beneficial activities of soil arthropods observed, duration of weed kill) and (iii) Attitude and practices (i.e time of herbicide application, precautions taken during herbicide application, health symptoms, amount spent on herbicide purchase, economic gains after herbicide use. The respondents to the survey were between the ages of 18-50 years.

2.3 Data Analysis

Descriptive analysis of the data was done into graphs and tables.

3. RESULTS

3.1 Farmers' Knowledge of Herbicide Hazards and Benefits

The predominant precautions observed by farmers before spraying herbicide at Motorway were to wear boots and consider wind direction. Farmers at Dzorwulu considered wearing nose mask, boots and overall as the main precautions observed before herbicide applications. Similarly, at Borhye, wearing boots and considering wind direction is the main precaution observed before herbicide application (Table 5). A lot more farmers at Borhye relies more on contact herbicide for treatment of weeds than any of the locations listed. This followed by a small significant numbers of farmers at Dzorwulu that also relied on contact herbicides. Motorway recorded the usage of systemic herbicides (Fig. 1). Farmers at the motorway depends more on selective herbicides than non-selective herbicides. At Dzorwulu, farmers have equal usage of both selective and non-selective herbicides. Finally, at Borhye farmers prefer non selective herbicides to selective herbicide in spraying the weeds on their vegetable farms (Fig. 2). About half of the farmers at Motorway have training on the use of herbicide and the other half did not. At Dzorwulu, a slight proportion of the farmers did not have training on the use of herbicide. A large number of the farmers at Borhye agreed to have training on the use of herbicide on their vegetable farms (Fig. 3). About 38% of the farmers at Borhye agreed to apply herbicide to the weeds in the morning. Also at Dzorwulu, 40% of the farmers applied herbicide to the weeds in the morning. Similarly, at Motorway, 41% of the farmers applied herbicide to weeds in the morning as shown in

Fig. 4. Skin problems are a symptom common to the farmers when they apply herbicides at the three localities. Fatigue and eye problem are predominant symptoms observed by farmers at Borhye. Vomiting is a common symptom to farmers at Motorway when they use herbicide on their farm (Fig. 5). In Table 4, 36.3% of the farmers at Motorway responded that it takes two days for the herbicide to kill the weeds while 43% of the farmers at Dzorwulu indicated that it takes between 2 to 5 days for the herbicide to kill the weed. About 38% of the farmers at Borhye reported that it takes 2 days for the herbicide to take effect.

3.2 Economic Benefit of Applying Herbicides

Quick action and effective control of weeds are the factors that influence the use of herbicide by farmers at the three localities. High cost and non-availability of the herbicide is a factor peculiar to farmers at Borhye when selecting herbicides for weed control (Fig. 6). Most of the farmers at the three locations spent between 50-100 cedis (\$12-24) annually on herbicides. A little more of the farmers at the three locations spent more than 300 cedis (\$72) on herbicide annually (Fig. 7). Majority of the farmers at the three localities gets 11-20% economic returns after they use herbicides on their vegetable farms. Most farmers at Borhye agreed to make more than 30% returns (Fig. 8).

Table 1. Organisms observed alive before herbicide application

Organisms	No of organisms observed alive		
	Motorway	Dzorwulu	Borhye
Earthworm	4	2	10
Mollusc	1	2	5
Mushroom	1	1	2
Insects	9	2	15
More than one type	5	2	10
None	0	2	0

3.3 Farmers' Knowledge of Benefit Soil Microorganisms

The survey showed that Borhye recorded Earthworm and Insects as the predominant arthropods observed before herbicide application. More than half of the arthropods observed are mainly earthworms and insects (Table 1). In the three (3) localities where the

survey was conducted, the farmers indicated that the arthropods don't die after herbicide applications. The herbicide does not kill the arthropods (Table 2). An estimated 29% of the farmers at Motorway stated that pollination is the main beneficial activities of the arthropods at the vegetable farms. Farmers at Dzorwulu (36%) observed burrowing as the main beneficial activities of these arthropods. Similarly, at Borhye, 38% of the farmers reported burrowing activity as the main beneficial activities of these arthropods (Table 3).

Table 2. Organisms observed dead after herbicide application

Organisms	No. of organisms dead		
	Motorway	Dzorwulu	Borhye
Earthworm	1	0	0
Mollusc	0	1	0
Insect	4	0	3
Centipede	0	1	1
None	5	3	11

Table 3. Beneficial activities of arthropods observed on cultivated soils

Activities of arthropods	No. of beneficial arthropods observed		
	Motorway	Dzorwulu	Borhye
Burrowing	8	4	13
Defecation	3	2	7
Predation	4	1	5
Pollination	9	0	0
More than one type	6	3	9
None	1	1	0

Table 4. Duration of herbicide activity

Duration (Days)	Duration of herbicide activity		
	Motorway	Dzorwulu	Borhye
Two	4	3	8
Three	3	0	1
Four	1	0	4
Five	2	3	3
More than 7	1	1	5

4. DISCUSSION

4.1 Perception of Herbicide Use among Farmers

Most of the farmers prefer morning to afternoon when applying herbicide. According to the farmers, this applying the herbicide in the

morning enable efficient killing of weeds. Also wind becomes considerably still enabling them to spray effectively without spraying their neighbouring farmer's vegetables. Wind direction was considered by majority when applying herbicide. This according to them prevents the insecticides from drifting onto a non-target and also landing on the applicator. Herbicide application by farmers is predominantly due to how quickly and effectively the herbicide works during their land preparation. Most farmers prefer a herbicide that works within a shorter time frame to a herbicide that takes longer to kill weeds. This is because of the urgency to begin planting of their vegetable seeds when the new season commences. The use of herbicide was observed to be high, probably because farmers assume that the only solution to pest problems is to spray more frequently and using different types of pesticides [11]. Even though farmers at two vegetable locations (Motorway and Dzorwulu) did not receive training on the use of herbicides, overall farmers at the three vegetable locations take into consideration precautions before herbicide spray. This is because of education and the knowledge they acquired about the dangers associated with exposure to herbicides and pesticides. Farmer knowledge about beneficial activities of certain arthropods is quite narrow. Majority indicated pollination and burrowing in the ground as the main beneficial activities they observed on the farm. This is because they see certain arthropods like earthworm and centipede burrowing into the ground. Also they observed bees and butterflies hovering around their farm. But as to what they

really doing on their farm is not much emphasized.

Table 5. Precautions observed among vegetable farmers

Precaution	No. of farmers		
	Motorway	Dzorwulu	Borhye
Read label before use	1	0	1
Wear nose mask	3	4	9
Wear overall	3	4	6
Wear boots	7	4	13
Consider wind direction	6	3	10
Use recommended dosage	3	3	8
None	2	1	1

4.2 Farmers' Knowledge of Herbicide Hazards and Benefits

In general, heavy and frequent use of herbicide is widespread in these three locations where vegetables are cultivated. This could lead to frequent exposure to herbicide which invariably could pose a problem to these farmers in the future. Gupta [12] indicated that the effects of exposure during a short duration can be delayed but there is possibility of a long term accumulation. This long term accumulation could pose health hazards such as carcinogens and disruption of endocrine receptors. However, the symptoms reported in this study are not specific to herbicide exposure, but could be due to

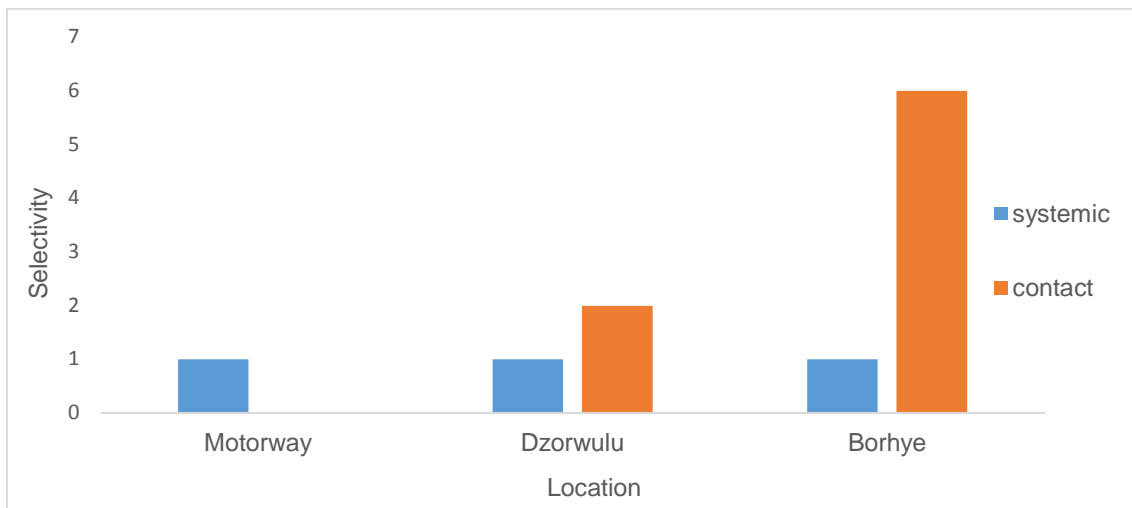


Fig. 1. Mode of action of herbicide selected for application among vegetable farmers in three areas of Accra

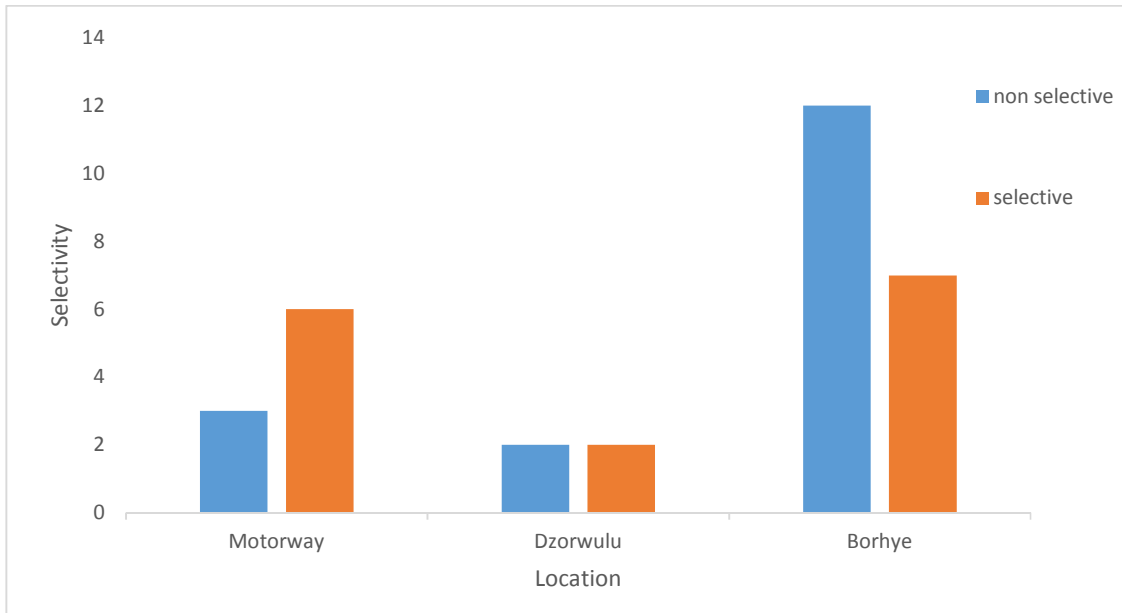


Fig. 2. Selectivity of herbicide among vegetable farmers in three areas of Accra

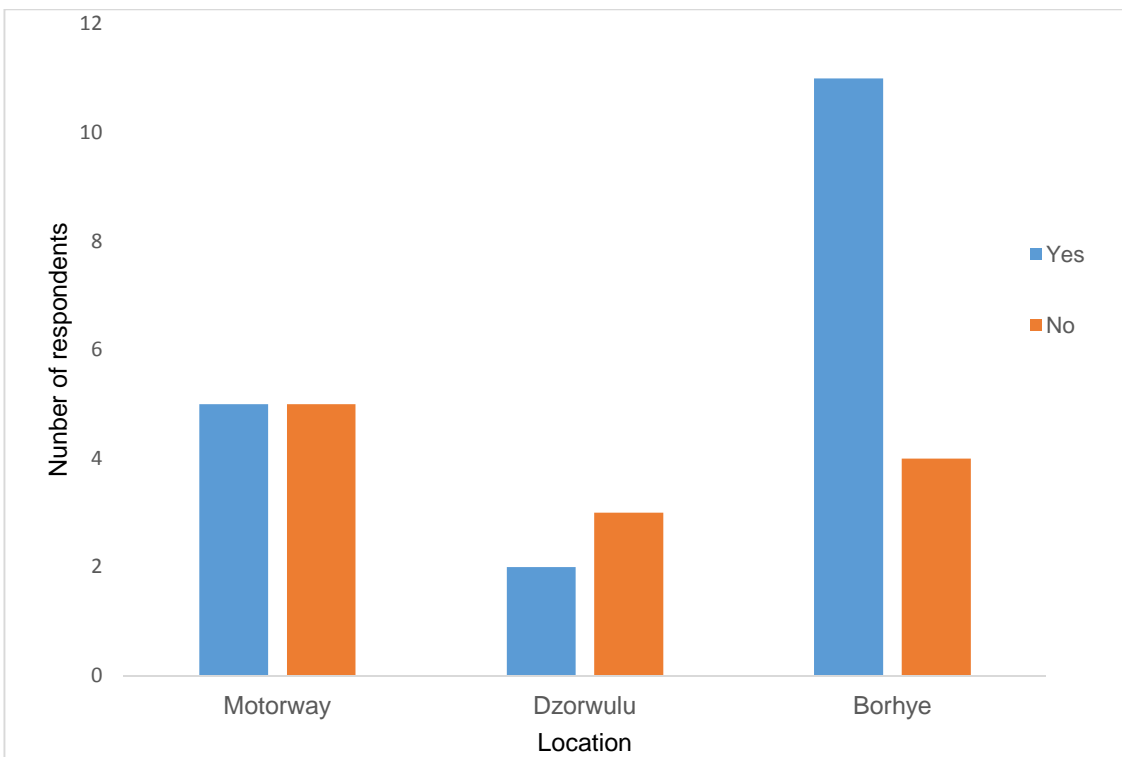


Fig. 3. Training on the use of herbicide among vegetable farmers in three areas in Accra

different causes, including general fatigue and malaria. In addition, there were few farmers who treated their own ailments resulting from herb use and hence the reason for low expenditure on

health costs. Similar studies carried out in Indonesia by Kishi et al. [13] and in Côte d'Ivoire [14] reported that pesticide applicators tend to accept a certain level of illness as an expected

and normal part of the work of farming and, do not report the symptoms in official health centres for formal medical assistance.

The regular use of herbicides by farmers over the years can be in part attributed to farmers' knowledge and perception in relation to effectiveness of herbicides, pesticide, farm size, weather condition, pest and price. Epstein and Bassein [15] reported that farmers use herbicides because they based the application on calendar

spray pesticide program without necessarily given much priority to health, safety and environmental concerns. Ngowi [16] revealed that farmers were not receiving agricultural extension service hence have attempted various means especially in pesticides use when dealing with pest problems but were constrained by the lack of appropriate knowledge. However, pesticide usage in the study areas seems to be highly influenced by manufacturers and pesticides vendors who were carrying out their

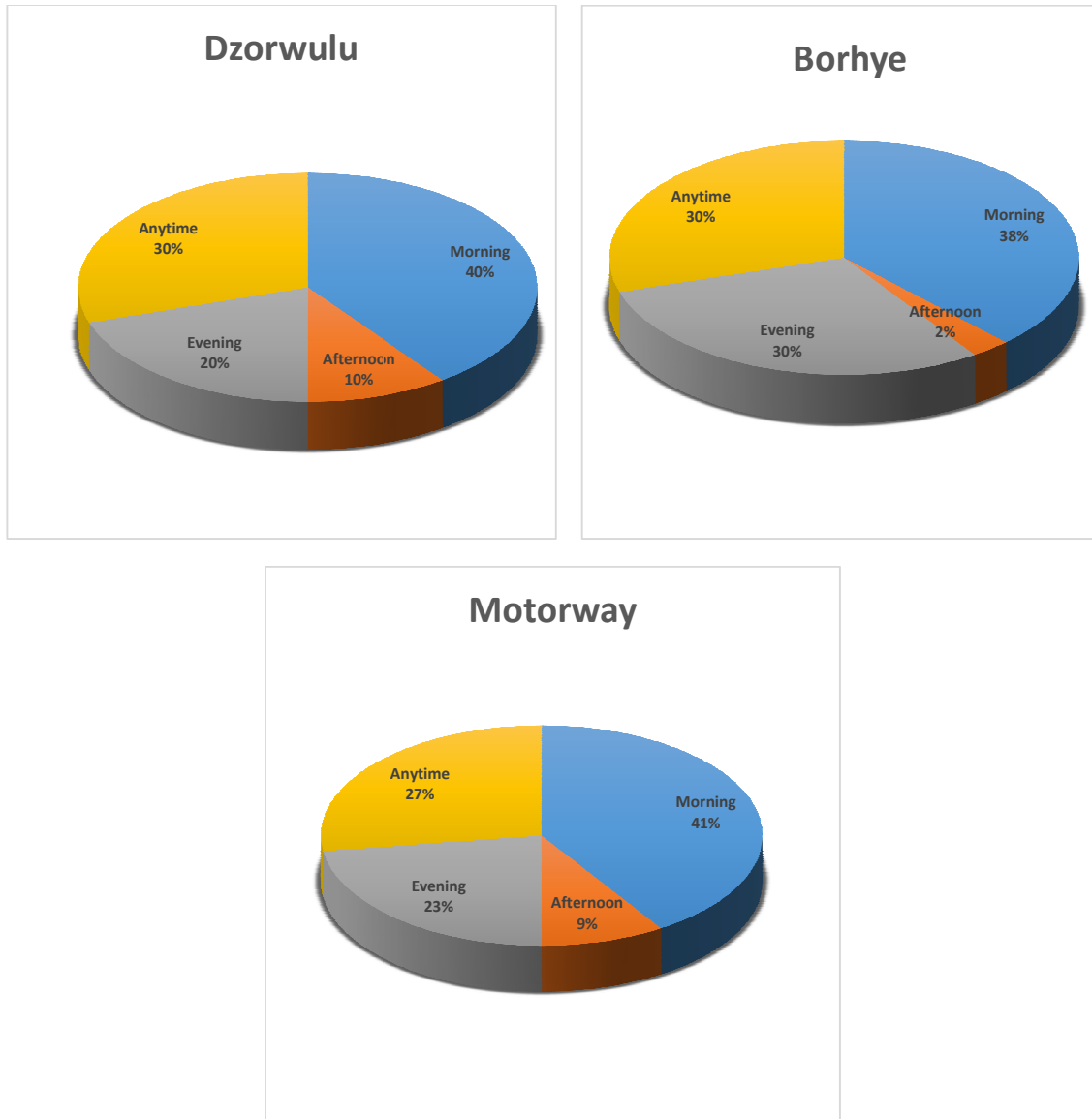


Fig. 4. Time of herbicide application at three vegetable farmer's locality in Accra

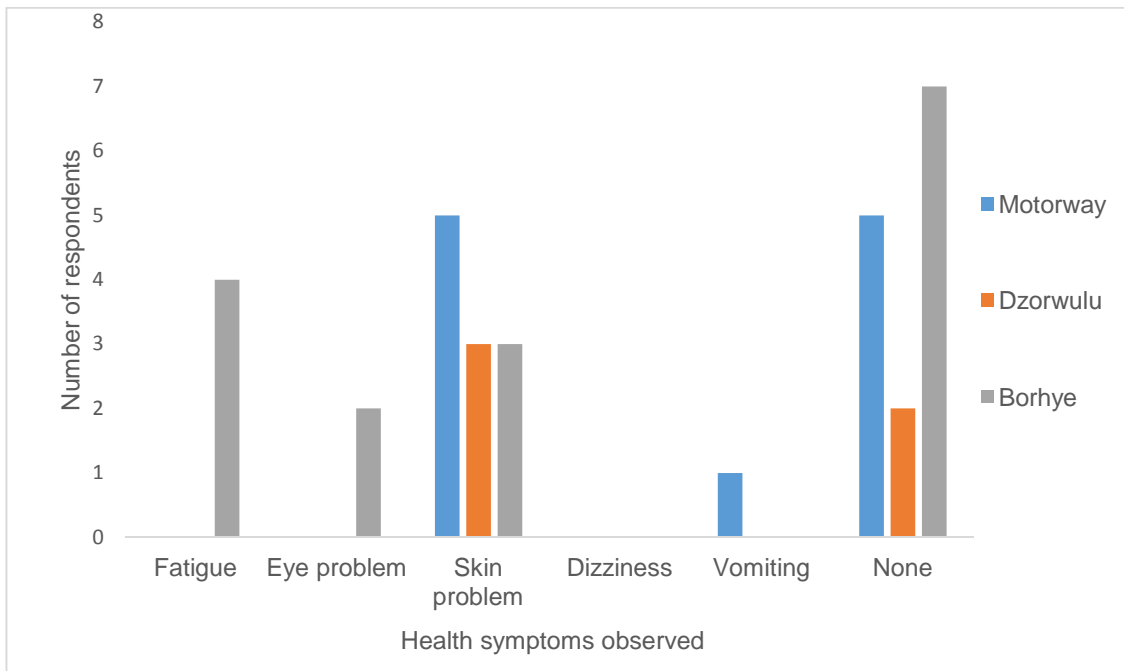


Fig. 5. Health symptoms observed after application of herbicide

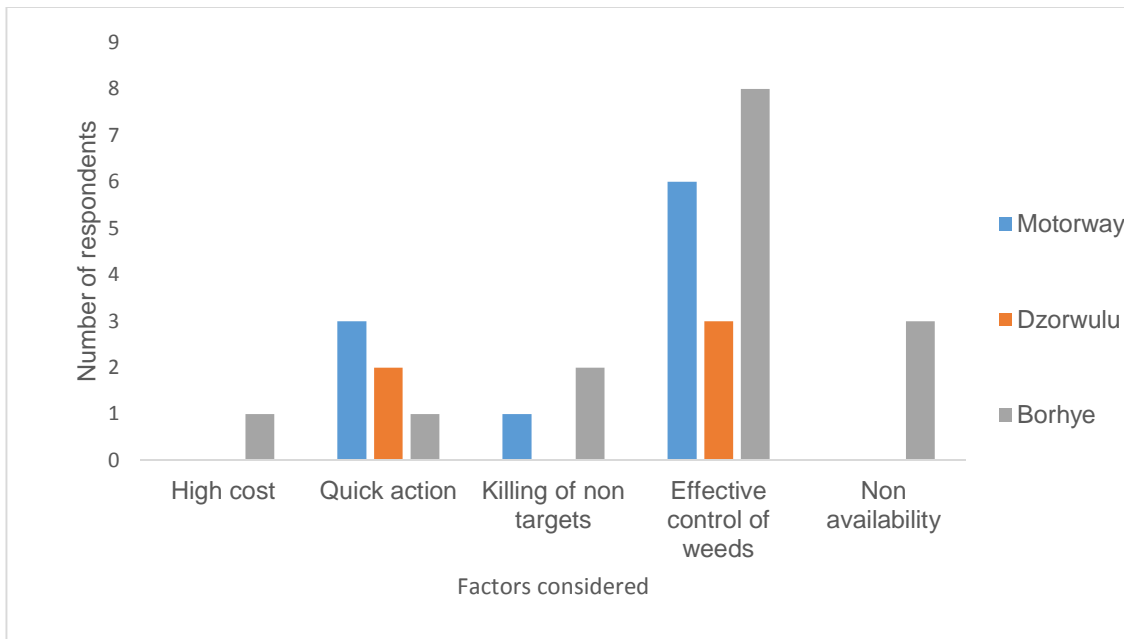


Fig. 6. Factors influencing the use of herbicides

business and very interested in achieving large sales of their pesticides. This is a typical situation in many developing countries where the choice of pesticides to be used by farmers is influenced by the suppliers [15,17]. Most of the income

generated after herbicide use is on the average. Other cost such as pesticides might affect the total profit made on these vegetable farms as pests and diseases are issues to contend with when it comes to vegetable farming.

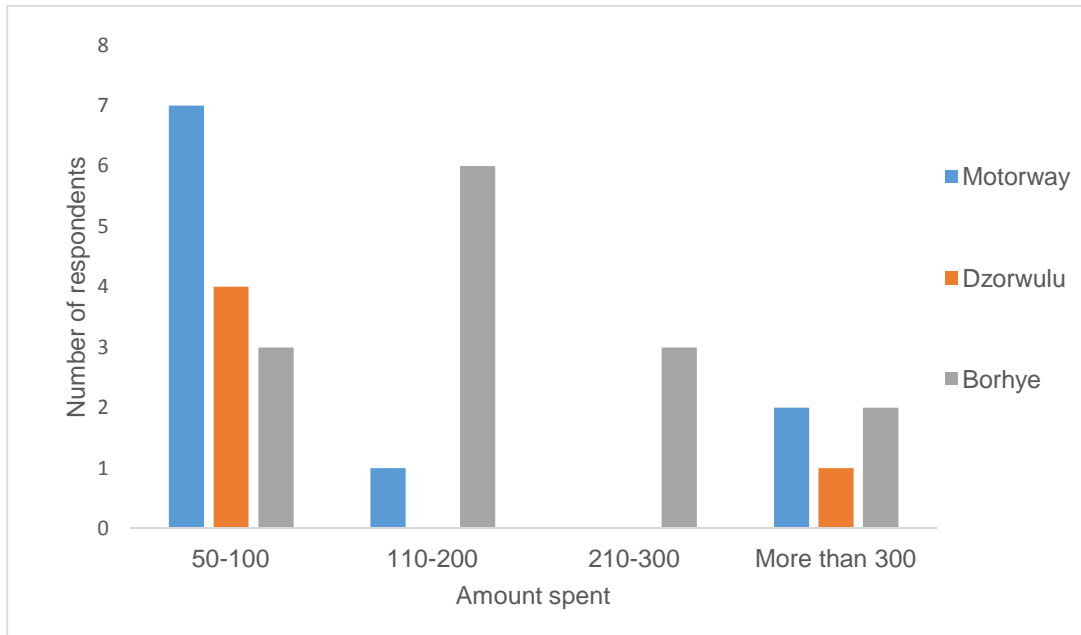


Fig. 7. Amount of money spent annually on herbicide

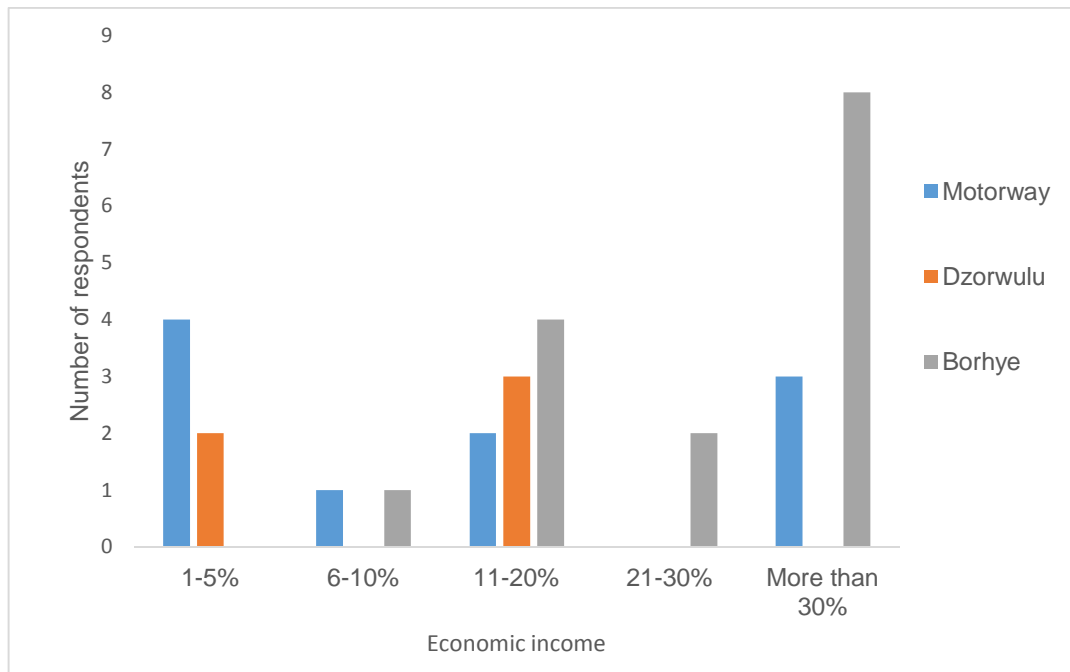


Fig. 8. Economic returns after use of herbicide

5. CONCLUSION

The findings of the study show that the perceptions and practices of the farmers on herbicide use still need to be improved, their

attitude is also still negative. The indiscriminate and frequent application of herbicide on the vegetable farms should be discouraged. Government should in no time discourage the use of herbicides that have been banned by

WHO and FAO. Government should educate farmers on Integrated Pest Management as a means of reducing or eradicating health hazards posed by herbicide usage. The government also has to play important role to spur growth of the vegetable farmers through policy development and program support. Research and development (R & D) and marketing are also very important issues or aspects to be look into in order to increase the production of vegetable products. The indiscriminate use of herbicides, often in excess. Evaluations such as these, guidelines to users and clarifications to the population should be encouraged.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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