MODELLING COCOA FARMER BEHAVIOUR CONCERNING THE CHEMICAL CONTROL OF CAPSID IN THE SEKYERE AREA ASHANTI REGION, GHANA

by

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DECLARATION AND APPROVAL

I, Eric Asare, hereby declare that this submission is my own work towards the M.Phil degree and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any degree of the University, except where due acknowledgement has been made in the text.

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DEDICATION

This study is dedicated to the Lord Almighty, from him my help comes from.

Secondly, it is dedicated to George Essel, Dorcas Donkor and my entire family.

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Eric Asare

June, 2011

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First and foremost, I thank God for His guidance, grace and steadfast love and for making this Thesis a success.

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ABSTRACT

This paper modelled the behaviour of the cocoa farmer in the Sekyere Area (Sekyere West, Afigya Sekyere and Sekyere Central), Ashanti Region, Ghana, concerning the chemical control of capsid. This was done by identifying the factors that determined the use of capsicide as well as the frequency of spray of capsicide (twice or more). It also quantified the effect of the factors on the use of capsicide and the frequency of spray of capsicide (twice or more) using a Tobit model and a Probit model respectively. A simultaneous Bi-Probit model was also employed to quantify the simultaneous effect of the factors that determined the frequency of use and quantity of use of capsicide. It was shown in the study that access to credit, household size and membership of a farmers' group had statistically significant and highly probable influence on the cocoa farmer to spray twice or more. Also, access to credit, farmer's experience, engagement in other economic activities, membership of farmers' group and input shop availability were significant and had the same effect on the likelihood of the farmer using capsicide.

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LIST OF ABBREVIATIONS

CODAPEC	Cocoa Disease and Pest Control
GOG	Government of Ghana
HA	Hectare
ICCO	International Cocoa Organisation
MOFEP	Ministry of Finance and Economic Planning
MOFA	Ministry of Food and Agriculture
PAS	Public Address System

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CHAPTER 1

1.0. INTRODUCTION

1.1. Background

Cocoa, *Theobroma cacao*, is an important cash crop in the world economy. In West Africa, cocoa is essentially a small- holder crop, cultivated on 1.2 to 1.5 million farms ranging in size from 1.2 to 2.8 hectares and employing about 10 million people (Padi *et al.*, 2008a). The bulk of the world's cocoa originates in West Africa, where Ghana and Cote D'Ivoire are the key producers.

In Ghana, cocoa has been and continues to be an important cash crop. It contributes substantially to the foreign exchange earnings of the economy. It is also a source of employment to Ghanaians, especially the rural people who are directly engaged in the production of the crop. It is therefore important to poverty reduction and the achievement of the United Nations Millenium Development Goals, *inter alia*.

Moreover, cocoa production and its marketing play an important role in education and human resource development in the country. Apart from providing vital resources for infrastructural development in the country, it directly provides scholarships to wards of cocoa farmers in the country. In the 2007 cocoa season, the Ghana Cocoa Board increased the number of scholarships to children of cocoa farmers from 2,500 to 7,500 beneficiaries (*Daily Graphic*, 30 November, 2007, pp. 32).

The crop has indirectly produced national edifices which are benefiting Ghanaians who have access to them. The Akuafo Hall of the University of Ghana, Legon, easily comes to mind as well as the Cocoa Clinic in Accra, Ghana, among others.

In addition, the cocoa sector form important linkages with the rest of the economy. First, in the manufacturing sector, cocoa production and its marketing form an important linkage with the processing sub-sector, including Cocoa Processing Company, West Africa Mills Company one and two, among others. These cocoa processing companies further generate employment and also increase government revenue through the export taxes levied on the processed cocoa products and local cocoa duty through the use of local cocoa beans in processing (MOFEP, 1999). Cocoa processing also stimulates the growth of ancillary industries, such as packaging material companies, food and beverage manufacturing and service providers (MOFEP, Ibid).

Second, it form linkages with the services sector, through Ghana Cocoa Board (COCOBOD), input importers and suppliers, Licensed Cocoa Buying Companies, among others. Through these important linkages, jobs are created through personnel contracted to manage these institutions. It also serves as a source of government revenue from the import taxes gained from the import of cocoa production inputs and local taxes gained from the sale of cocoa beans to Cocobod by Licensed Cocoa Buying Companies.

Moreover, there are several studies which have shown the putative cardio-protective action of cocoa. These studies give an indication of the health benefits obtained from the consumption of cocoa and cocoa products, specifically, a reduction in hypertension and its related diseases (Buijsse *et al*., 2006; Hodgon *et al*., 2006; Polarity *et al.*, 2006).

Cocoa by-products are also an important feed in animal production. Elena *et al*., (2007) showed that cocoa fibre obtained from cocoa husks has the potential to contribute to a reduction of cardiovascular risks in livestock. This is important as far as the nutritional composition of animal feed is concerned. Thus, application of cocoa fibre as a functional ingredient in animal feed is important in ensuring and improving the general health of animals through better nutrition. From the foregoing, there is no doubt that cocoa production is very important.

Unfortunately, the production of cocoa is constrained by several factors. Among these factors is the incidence of cocoa diseases and pests. Johny *et al.*, (2003) and Bailey *et al.*, (2005) report that the yield of *Theobroma cacao* is limited by pests and diseases and that they are important destabilising factors in many producing countries. Dormon *et al.* (2007), showed that 30 percent of the cocoa produced in Ghana annually is lost to pests and diseases.

Over the past five years, the Government of Ghana (GOG) has been implementing several programmes to control and prevent cocoa pests and diseases, especially capsid attack and Black Pod Disease in the country. Indeed, in 2005, GOG spent an amount of 302,667 US dollars on the control of the capsid bug and BlackPod disease in the country, which was expected to cover about 90 percent of total land area under cocoa cultivation (GOG, 2006). Specifically, the Government of Ghana introduced the Cocoa Diseases and Pests Control Project (CODAPEC), which involves mass spraying of cocoa farms using synthetic insecticides and fungicides against capsid and Black Pod respectively. This is done at most twice a year for the cocoa farmers.

Personal interview with agricultural extension officers and other relevant stakeholders in the Sekyere Area in the Ashanti Region (specifically, Sekyere West, Central and Afigya Sekyere Districts) on the 13th of November, 2008, revealed that these districts which are important cocoa growing areas in the Ashanti Region, and for that matter Ghana, are badly affected by capsid and has been benefiting from the CODAPEC programme since its inception.

1.2. Problem Statement

Capsid or Mirid can be controlled by various methods, viz., biological, cultural, chemical, integrated pest management practices (IPM), *inter alia*. Improved cultural methods involve shade and canopy management. Integrated Pest Management strategies comprise the use of the black ant (*Dolichoderus thoracicus*) and *Oesophylla margarine* as biological control agents; the identification and use of resistant germplasm; and the use of pesticides especially organochlorine insecticides (Bailey *et al*, 2005; ICCO, 2007) .

Among the control measures of capsid, chemical control is the most effective in West Africa and for that matter Ghana (Johny *et al*, 2003; Adu-Acheampong *et al*, 2007; Dormon *et al*, 2007; ICCO, 2007). Spraying of the insecticide is done four times a year from the period August to December, leaving out November for harvesting and to ensure that the treatment coincides with the main period of Mirid population increase, which is between August and November (Adu-Achempong *et* *al*, 2007; ICCO, 2008; Padi *et al.*, 2008a; www.cocobod.com.gh, accessed 10 October, 2008).

The recommended insecticides for use in controlling capsid in Ghana are Confidor 200SL and Cocostar EC. Application is done using a motorised mist-blower (Padi *et al, op cit.*; www.cocobod.com.gh, accessed 10 October, 2008). Chemical control of capsid, though effective, comes with its own challenges following improper applications and failure to adopt full research recommendations regarding the application of the insecticide (Dormon *et al.*, 2007).

As already indicated, the Government of Ghana has been spraying cocoa farms against capsid and Black Pod at most twice per season in the country free of charge for cocoa farmers since 2003 through the Cocoa Diseases and Pest Control (CODAPEC) programme. A possible explanation for the two times spray instead of the four by the government is inadequate funds. For chemical control to be effective and sustainable, the recommended spraying regime as to the quantity and number of times (frequency) the capsicide are to be sprayed should be understood. Currently, the recommended practice is for farmers to spray their cocoa plantations four times a year (Dormon *et al.*, 2007). Therefore, it is important for the farmers either to spray their farms through their own initiative, which is four times a year or complement what the government is doing, so as to mitigate the incidence and spread of this devastating insect pest.

However, whether farmers perform the additional two sprays after the CODAPEC programme or all the four sprays themselves and the effects of the factors shaping this behaviour of the cocoa farmers in the Sekyere Area are largely unknown. This therefore raises the following issues: What are the effect of the determinants of the quantity of capsicide used by cocoa farmers on their farms per unit time? What are the effect of the determinants of the number of times farmers spray their farms? These are the issues which the present study addresses.

1.3. Objectives of the Study

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The primary objective of this study is to model the behaviour of cocoa farmers concerning the chemical control of capsid in the Sekyere Area of the Ashanti Region of Ghana. The secondary objectives are the following:

- To identify the factors that determine the quantity of capsicide use by cocoa farmers on their farms.
- To identify the factors that determine the frequency of spray of capsicide by cocoa farmers on their farms.
- To estimate the quantitative effect of the factors that determine the quantity of use of capsicide by cocoa farmers on their farms.
- To estimate the quantitative effect of the factors that determine the frequency of spray of capsicide by cocoa farmers on their farms.
- To propose policy recommendations relating to the empirical results of the study.

1.4. Justification of the Study

Any study in Ghana which focuses on cocoa such as the present study is very important. As already mentioned, cocoa production and its marketing undoubtedly play an important role in the socio-economic development of Ghana. However, cocoa capsid has been and will continue to be a devastating insect pest to the crop.

For now chemical control is the most effective means of controlling this important insect of cocoa which is done at the recommended rate of 4 times a year. To be able to effectively control capsid, there is the need to understand the cocoa farmer behaviour to use and spray capsicides correctly (twice or more). It is assumed in the present study that cocoa farmers in the study area are beneficiaries of the CODAPEC programme, which sprays at most twice a year for the farmers free of charge. It is therefore important for the farmers to either spray their farms themselves (which is four times a year) or complement what the government is doing so as to curb the incidence and spread of this insect pest. The study therefore seeks to identify the factors that tend to influence the cocoa farmer to use capsicide and spray twice or more as well as their quantitative effects. There is scanty rigorous research concerning the socioeconomic factors and their quantitative effects on the use and frequency of spray of capsicide. This study therefore contributes to narrowing the gap in knowledge concerning the chemical control of capsid. Also, policy recommendations will be proposed relating to the results obtained from the study.

1.5. Organization of the Study

The present study will be comprised of five chapters. Chapter 1 includes the background statement, the problem statement, the objectives, the hypotheses and the relevance of the study. In chapter 2, a review of documents, articles and research reports relating to the theme of the study is made. Chapter 3 includes the methodology employed in achieving the objectives of the study. The study area as well as all relevant concepts, variables and data used in the present study are described. Chapter 4 presents the empirical results and its discussion. Finally, Chapter 5 closes with summary and policy recommendations.

CHAPTER 2

2.0. LITERATURE REVIEW

This chapter reviews the relevant literature relating to the theme of the study. First, literature on the capsid bug and its relevance to cocoa production is presented, followed by a review of the control measures of the insect bug, especially chemical control. Lastly, the literature on the socio-economic factors influencing the chemical control of capsid is reviewed.

2.1. Capsid Bug and Its Relevance to Cocoa Production

Among the various pests that affect cocoa production worldwide, the most important is capsid also called Mirid. In Ghana, it has been recognised as a serious pest since 1908 due to its devastating effect on cocoa production (ICCO, 2007). Also, there are several studies that have documented the devastating effects of the insect pest. For instance, about 25 to 30 percent of the total cocoa production in Ghana is lost through capsid damage. Specifically, Padi *et al*., (2008a) put the total cocoa loss (dry cocoa) in 1957 to about 60,000 to 80,000 tonnes, which is about 25 percent of the total dry cocoa produced in Ghana. Hence, the Government of Ghana's annual expenditure of millions of United States dollars (US$) on the purchase of insecticides, which are highly subsidised for farmers to control capsid (Padi *et al*., *op cit.*).

According to Padi (2008b), there are about forty species of capsid (Heteroptera: Miridae) feeding on cocoa worldwide, belonging to the mirid subfamily *Bryocorinae*. In the subfamily *Bryocorinae*, it is further separated into two, *Monaloniini* and *Odoniellini*. The *Monaloniini* includes the two genera, *Helopeltis* and *Monalonion*; while the *Odoniellini* includes the eight genera *Boxia, Boxiopsis, Bryocoropsis, Distantiella, Odoniella, Platyngomiriodes, Pseudodoniella* and *Sahlbergella* (Entwistle, *op cit.*). However, the most important species relating to Ghana are *Distantiella theobroma* (Distant), *Sahlbergella singularis* (Haglund) and *Holopeltis sp*. (Adu-Acheampong *et al.*, 2007; Dormon *et al.*, 2007; Padi *et al.*, 2008a).

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The life cycle of the capsid bug, begins with the laying of eggs by an adult female after mating with an adult male capsid. The eggs (about 60) are laid in the outer layer of pods and beneath the bark of young shoots (ICCO, 2007 and Padi *et al.*, 2008a). There are five nymphal stages and the incubation period varies from 12 to 17 days, with each nymphal stage lasting for about 3 to 6 days (Padi *et al.*, *op cit.*).

Capsid bugs (Heteroptera: Miridae) cause damage to the cocoa tree through its feeding. The feeding action of this insect is essentially through the piercing with their needle-like stylets (mouthparts) into plant tissues and injecting toxic saliva (spit) into the plant causing the internal tissue of the plant to die (Johny *et al.*, 2003). N'Guessan *et al.* (2007b), also state that capsid may feed on every part of the plant with the exception of the leaves and roots. They further asserted that both mature and immature stages of the pest cause damage to the vegetative parts of fruiting structures. Feeding by cocoa mirid is characterized by dark markings known as "lesions" on both pods and shoots, which results from the collapse of the plant tissue caused by the toxic saliva injected into the plant through its feeding. According to Padi (2008b), the shape of the lesion created by the Mirid is somewhat characteristic of the mirid species involved. For example, lesions resulting from the feeding of

Helopeltis sp. are roundish whilst those by *Distantiella* and *Sahlbergella* tend to be elliptical with the long axis parallel with that of the stem (Padi, *op cit.*)

Adu-Acheampong *et al.*, (2007), showed that young cocoa trees (trees under 3 years) are particularly susceptible to capsid attack which delays their fruit bearing stage to several years. N'Guessan *et al*, (2007a), showed that the most important and serious damage is inflicted on the trunk, the young shoots and cherelles. Again, N'Guessan *et al*, (2007b), reports that there may be a secondary infection of the wounds by a pathogenic fungus, *Calonectria rigiduiscula*, causing cankering or bark roughening, destruction of the flower cushions, and a severe dieback of twigs and branches.

In Africa and for that matter Ghana, there are two predominant patterns of Mirid attack known as the "capsid blast" and the "capsid pockets". While "blast", a dry season phenomenon, is characterised by a concentration of Mirid attack on a large area of exposed cocoa trees (specifically on the fan branches), causing diffuse damage resulting in their terminal death. "Pockets" on the other hand, occur when the canopy of more or less discrete group of trees, up to about one hundred, is strongly damaged by intensive feeding on the fan branches (Padi *et al.*, 2008a; Padi, 2008b). Moreover, there are two generally recognisable phases of tree deterioration as a result of capsid attack on cocoa trees. These are the "stag-headed" trees, which results from the death of the crown of trees following persistent mirid feeding on fans and regenerative shoots from *Calonectria* dieback, and "bare poles" which result in a total loss of canopy (Padi, 2008b).

2.2. Control of Capsid

Cocoa production and its marketing is the backbone of a number of cocoa producing countries, particularly Ghana. Thus, the control of capsid on cocoa farms is very important. According to ICCO (2007), “capsids are well known for their sporadic distribution, cryptic habits and highly damaging effects”. This makes them difficult and extremely important to control. For now, research on the capsid bug recommends that chemical control is the most effective mode of controlling the bug (Adu-Acheampong *et al.*, 2007; Ayenor *et al.*, 2007; Dormon *et al.*, 2007; ICCO, 2008; Johny *et al.*, 2003; New Agriculturist, 2008; www.cocobod.com, accessed October 10, 2008 and so on). For instance, Dormon *et al.*, (2007), report that capsids are inconspicuous and so make scouting an inappropriate option. They propose its control through the prophylactic spraying of synthetic pesticides monthly from August to October and in December.

Chemical control of capsid though effective, comes with its own challenges if its adoption does not conform to research recommendations. There are concerns about the chemicals and their potential effect on human health and the environment, especially their potential negative effect on bio-diversity, contamination of water bodies, and resistant build-up by the target insects (Dormon *et al.*, 2007). For instance, Dormon (2007), report of a secondary pest outbreak of *B. thalassina*, which became a major pest of cocoa as a result of the widespread use of synthetic insecticides in Ghana.

Ghana is zoned into two cocoa growing areas for capsicide application; that is the Northern zone, which comprises the Brong Ahafo and the Ashanti Regions; and the

Southern zone, which comprises the Central, Eastern, Western, and Volta Regions (www.cocobod.com, accessed October 10, 2008). The recommended insecticides for capsid control in Ghana are Confidor 200SL and Cocostar EC. Each insecticide is used in a given zone for 2 years (seasons) and switched over to the other to break the possible resistance in the insect population (www.cocobod.com, accessed October 10, 2008)

Despite its challenges, chemical control remains the most effective mode of capsid control. However, there are other alternative methods that can complement chemical control of capsid. First, is the use of an Integrated Pest Management approach, especially the use of aqueous neem extract (bio-pesticide). In a study conducted in the Eastern Region of Ghana, it was found out that a 250g/l of aqueous neem extract application was effective in reducing the capsid *H. antonii* population to almost 80 percent (Obeng-Ofori, 2004). Dormon *et al.*, (2007), recommended the use of aqueous neem seed extract (ANSE) as a potent mode of controlling capsid bugs in Ghana. This assertion by Dormon *et al.*, (2007) is very important considering the pesticidal properties of neem seeds. For instance, Padi (2008b) reports that, the leaves, fruits and the seeds of the neem tree, *Azadirachta indica* A. Juss: Meliaceae contains active triterpenoids including azadirachtin, salannin, nimbin, deacetylnimbin and thionemone. Studies have been conducted at CRIG to test the crude seed extract and commercialization of its seed oil for capsid control (Padi, *op cit.*)

Also, cultural techniques viz., installing temporary shading in young plantings, upkeep and sucker removal in farms and the maintenance of a complete canopy, have been routinely applied as a sole control practice or in addition to the rational use of pesticides with the aim of minimizing pest damage to cocoa plantations (Johny *et al*., 2003). Again, cocoa farms most often have a number of trees as part of its ecosystem. These trees provide shade as well as other mutualistic associations with the cocoa trees. However, it known that some of these trees serve as alternative host to Mirid and should not to be used as shade on the cocoa farms. Some of these trees are the *Cola sp.*, other *Theobroma sp.*, *Ceiba pentandra*, *Citrus* sp., and *Adansonia digitata* (Padi, 2008b; Johny *et al*., 2003).

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Moreover, the use of natural enemies of the capsid bug as a biological control measure has received research attention. *New Agriculturist* (2008), reports that *Beauvaria bassiana* has been reported to be lethal to some mirid species in Malaysia. Therefore, other fungal pathogens of Mirid, such as *Bacillus* and *Apergillus* spp. may also have potential for biological control of the capsid bug (New Agriculturist, *op cit*). In addition, it has been reported that cocoa farmers in Indonesia have been aware that damage is less when cocoa trees are colonised by ants, notably *Dolichoderus thoracicus* which is not aggressive to plantation staff (Johny *et al*., 2003). Therefore, ants have been introduced as a component of integrated pest management in Indonesia (against *H. antonii* and *H. theivora*) and in Malaysia, against *H. theobromae*, (Johny *et al*., *op cit.*).

The use of sex phemorones, in the mass trapping of capsid especially male capsid, has also received research attention in the control of cocoa capsid (see for instance; Ayenor *et al*., (2003); Padi, 2008b). Johny *et al*., (2003), also report that genetically modified germoplasm, especially hybrids obtained from clones with mirid tolerance, has the potential of controlling capsid. Specifically, they noted that Cultivar SNK 413 is less vulnerable to attack than Catongo varieties; and also stressed that the low water content in the stems of some Upper Amazon cultivars is also a major factor in making these clones unattractive to Mirid (Johny *et al*., *op cit.*).

2.3. Empirical Literature on Socio-Economic Factors and Chemical Control of Capsid

Chemical control of capsid is currently the recommended mode of controlling capsid in Ghana. However, the socioeconomic and demographic factors influencing the chemical control of the capsid bug are largely unknown. Despite this seemingly lack of research attention, studies on the socioeconomic and demographic characteristics of farmers in general and the adoption of agricultural technologies have received considerable research attention in other crops.

There is a growing consensus among research findings, concerning the importance of socioeconomic and demographic characteristics of farmers and the adoption of agricultural technologies. Among others, they are farmer's age, educational level, access to credit, gender, farm size, hiring of labour, access to information, membership of farmer's organization and experience (see for instance, Nzomoi *et al*., 2007; Tovignan *et al*., 2004; Doss et al., 2003, Degu *et al*, 2000; and so on).

Tovignan *et al.*, (2004), reports that predicted gender index, education level of the head, the topographic status of the land, the farmer's experience about pesticide accidents, access to credit, off-farm income, age of the farmer and the number of extension visits farmers receive per month, have significant and positive influence on the adoption of organic cotton in Benin. However, land tenure and number of ruminant animals were not significant in his study. Nkonya *et al*, (1997) cited by Tovignan *et al.*, (2004), found a positive relationship between education of farmers and the probability of adoption of improved maize seed in northern Tanzania. Doss *et al.*, (2003) also showed that farmers' characteristics that are likely to be associated to the use of improved technologies include age or experience, education, wealth (including land), availability of cash or credit to purchase inputs, access to information and access to labour. However, he fell short in specifying the kind of agricultural technology being studied.

Degu *et al*., (2000), in a study on the assessment of the adoption of seed and fertilizer packages and the role of credit among small holder maize production in Ethiopia, used a Tobit analysis to model the farmers adoption behaviour concerning the allocation of land to improved maize varieties. They found out that extension service, use of credit and membership of an organisation have significant influence on the probability of land allocation to improved maize varieties. In the same study, this time using a Logit analysis, they found out that off farm income, the use of hired labour and access to credit have significant influence on the likely of adoption of fertiliser. Nzomoi *et al*. (2007) found out that farmers' level of education, role of government, funds availability, and membership of professional bodies influence the adoption of technologies positively. This study also fell short in specifying the kind of technology being investigated.

Hattam *et al*., (undated), found membership of a farmers' association as likely to influence the adoption of certified organic production in Mexico. However, they found out that farm size, farmers' experience and farmers' educational level and age have insignificant effects on the likelihood of adoption of certified organic production (Hattam *et al., Ibid*). Contrary to results of Hattam *et al*., Payne *et al*., (2003) found significant, the operator's age and farm size, but insignificant the influence of educational level of the operator on the likelihood of adoption of Corn root worm (CRW) Bt seed technology in U.S.A. Zegeye *et al*., (2001), reports that attendance of agric training courses, radio ownership, membership of producer cooperatives, farm size, access to farm credit and total livestock units owned exert high influences on the adoption of chemical fertilizer use. They also found out that farm size, contacts with extension agents, farmers' educational level, and access to credit and attendance of training courses have significant influences on the adoption of improved wheat varieties (Zegeye *et al*., Ibid).

Again, Ouma *et al*., (2002) found significant, the influences of gender and hiring of labour on the adoption of improved maize seed technology in Kenya, but not significant household head, educational level, farm size, credit, extension and farmers' group membership. However, hiring of labour, credit and educational level of the household head had significant influences on the quantity of fertilizer use (Ouma *et al*., *op cit*.). Also, Kebede *et al*., (1990) cited by Kalyebara (undated) observed that farm size, farm income, family size, access to information, and education as having significant effects on adoption of fertilizer, single-ox, and pesticide technologies in Ethiopian crop production systems.

These studies are very important for the present study. It shapes the direction of the study. Also, in all these studies use was made using of one binary model to investigate the factors that are likely to influence a farmer to use an agricultural technology. This study also does that. However and more importantly, it also uses a simultaneous Bi-Probit model to capture the effects of a farmer's socioeconomic and demographic factors on the frequency of spray of capsicide and the use of capsicide per cocoa season; as well as calculating the marginal impacts of these factors on the use of capsicide and frequency of spray.

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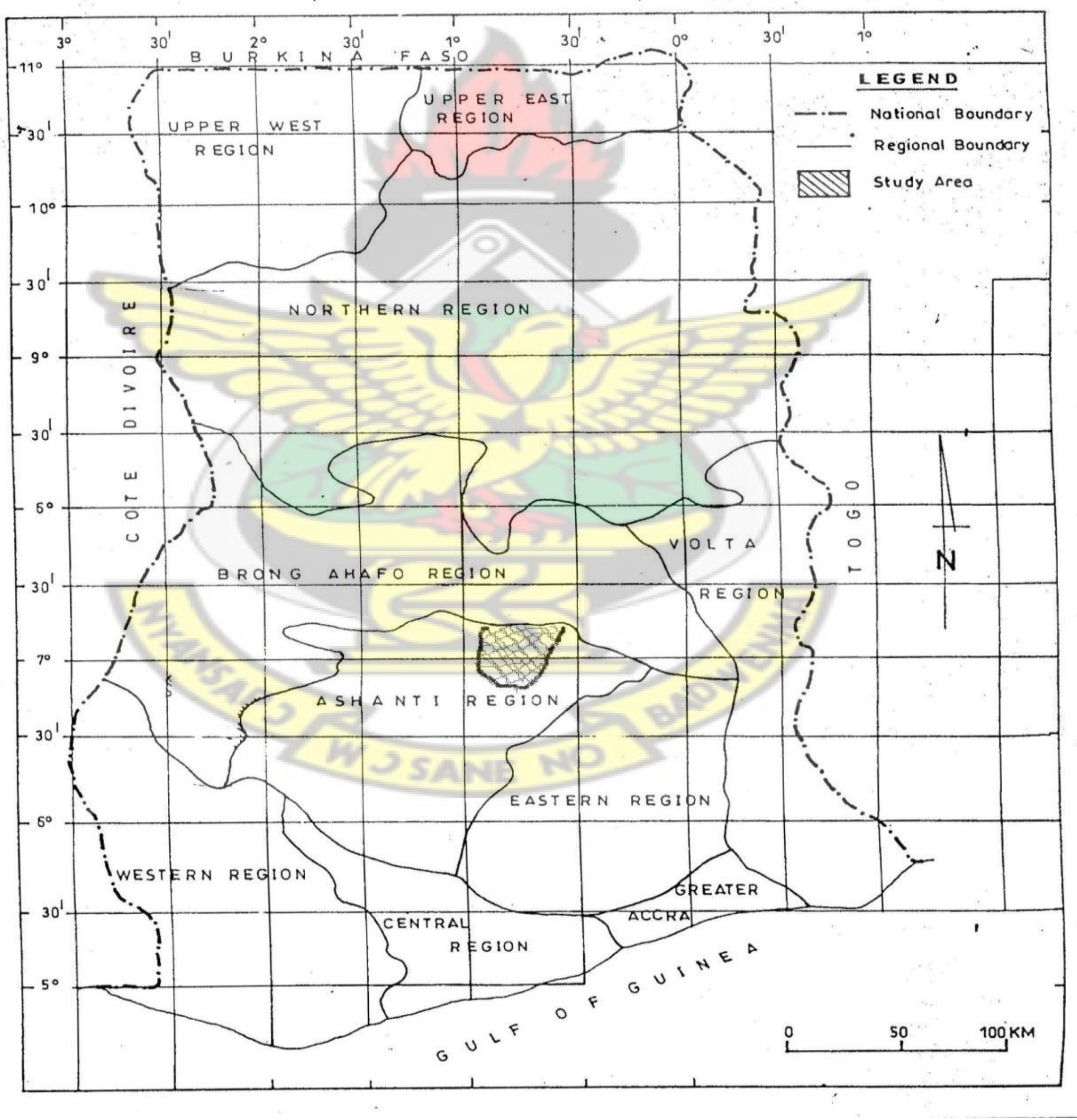
CHAPTER 3

3.0. METHODOLOGY

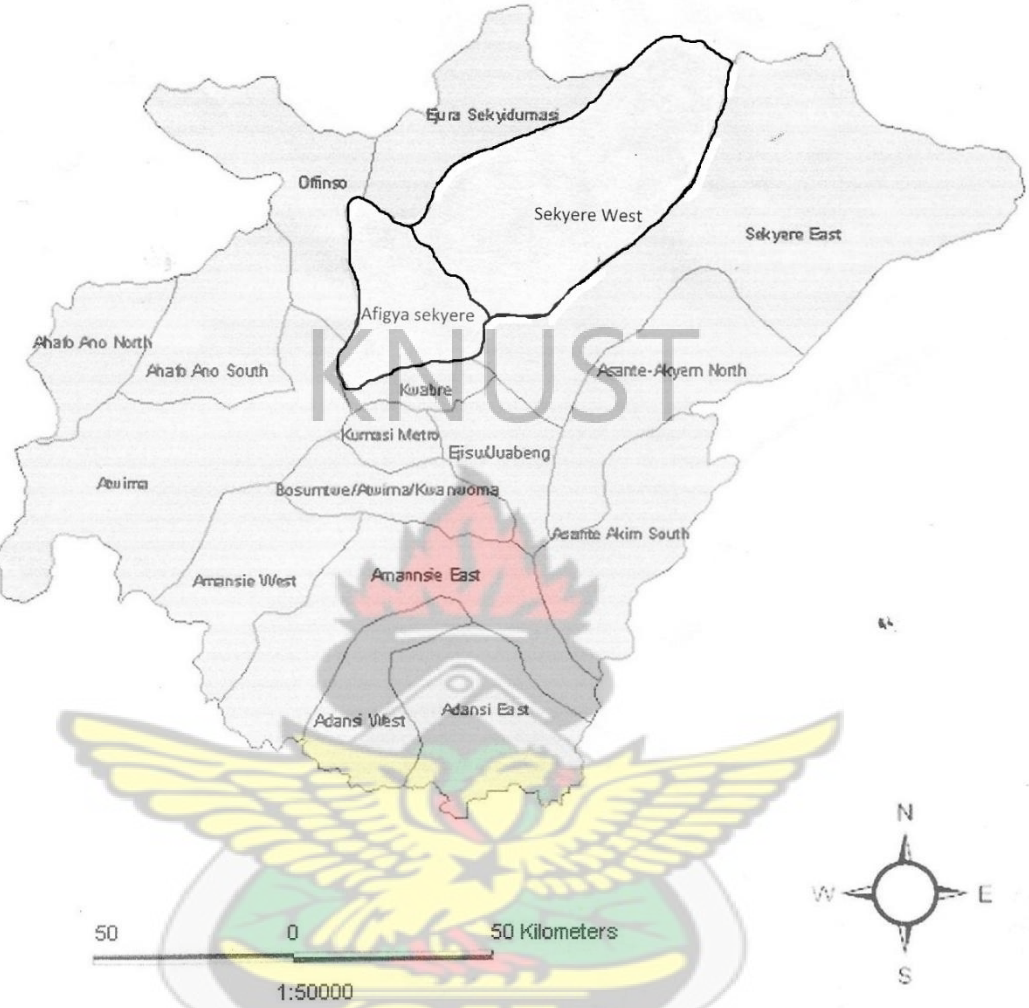
This section describes the study area. Also, the source and type of data, sampling technique, method of data collection as well as method of data analysis are presented and described. This is followed by the theoretical foundation and empirical framework of the models used in the present study.

Figure 1. Map of Ghana Showing the Study Area



Source: City and Planning Unit, Kumasi

Figure 2. Map of Ashanti Region Showing the Study Districts



Source: City and Planning Unit, Kumasi

3.1. Profile of the Study Area

In this section, the areas of study notably, Afigya Sekyere, Sekyere Central and Sekyere West are described (Figure 1). Specific details to be covered under each district are the demographic characteristics, climate, soils/topography, vegetation, population and agricultural/other economic activities. Sekyere Central is a new district carved out of Sekyere West, through an Executive Instrument (E.I.) and inaugurated on the 29th of February, 2008. Therefore, information relating to Sekyere West is also true for Sekyere Central. The capital of the Sekyere Central is Nsuta.

3.1.1. Afigya Sekyere

The district is located in the north central part of Ashanti region, Ghana. It has a total area of 780 square kilometres, forming about 3.27% of the total land area of the region (www.ghanadistricts.com; accessed March 12, 2009). According to the 2000 Population and Housing Census, the population of the district is 119,085 with an annual population growth rate of 3.1 percent. It has Agona as its administrative capital and shares boundaries with Ejura-Sekyeredumase to the north, Mampong to the east, Sekyere East and Kwabre East to the South and Offinso Municipality to the West. Specifically, it lies between latitudes 6^0 $50^/$ N and 7^0 $10^/$ N and longitudes 1^0 $40^/$ W and 1^0 $250^/$ W (City and Town Planning Unit, Kumasi). The total housing population in the district is 12,648 with an average household size of 5.4 (2000 Population and Housing Census).

In this district 48.28 percent of the total population are males while 51.72 percent are females (2000 Population and Housing Population). The most populous town in the district is Wiamoase with about 11,000 people (2000 Population and Housing Census). This is probably as a result of the availability of services and the easy access to marketing centres in the town. The labour force (the economic active group i.e. 15 to 64 years) is 48.6 percent of the total population (2000 Population and Housing Census).

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3.1.1.1. Climate and Vegetation

The climate of the district is equatorial. According to the Ghana Meteorological Service, Kumasi, the district has a bimodal rainfall regime. The major rainy season occurs between March and July, with the minor rainy season occurring between September and November. The months, December to March are usually dry and characterised by high temperatures, and early morning fog/moist and cold weather conditions. Temperatures are usually high throughout the year with a mean temperature of about 27^0C. Humidity is high during the rainy season. However, the months December to February, record very low humidity.

Again, the vegetation can be described as moist semi-deciduous. The district lies within a rain forest. The forest consists of three layers namely: the upper, middle and lower layers. The upper layer is made up of very tall trees, whilst the middle and lower layers consist of medium and lower heights respectively. The forest abounds in different species in tropical woods of high economic value such as Wawa, Odum, Mahogany and Sapele (www.ghanadistricts.com, accessed March 12, 2009).

3.1.1.2. Topography and Soils

The greater part of the district falls within dissected plateaus with heights reaching 800m and 1200m above sea level, which forms part of the Mampong-Gambaga scarp (MOFA, Afigya Sekyere District, 2009). The district is well drained by many streams and rivers. Notably among them are the Offin, Oyon, and Anabkro rivers. There are two geological formations in the district, namely the Voltaian and Dahomeyan formations (www.ghanadistricts.com, accessed March 12, 2009). The Voltatian formation is formed through the deposition of sediments over time. This mainly consists of sandstones, shale, mudstone and limestone. The Dahomeyan formation, on the other hand, is one of the oldest formations and it consists mainly of metamorphic rocks such as gneiss and schist. The main soils types in the district are the Kumasi-Offin compound association, Bomso-Offin compound association, Jamasi Simple association, Boamang Simple Asscociation, Bediesi-Sutawa association and Yaya-Pimpimso association (MOFA, Afigya Sekyere District, 2009).

3.1.1.3. Agricultural and Other Economic Activities

The occupational distribution in the district shows that, the agricultural sector, industrial sector and services/commercial sector employs 64%, 32% and 4% respectively of the total labour force in the district (www.ghanadistricts.com; accessed March 12, 2009). According to the Ministry of Agriculture, Afigya Sekyere, the district has a cultivable area of 53,250 hectares excluding pastures and forest reserves. The major food crops cultivated include cassava, plantain, yam, cocoyam, and maize. Cocoa, citrus, coffee and oil palm are the major cash crops cultivated. Also, about 21 percent are subsistent farmers, 6 percent commercial farmers whereas 73 percent cultivate at both levels (MOFA, Afigya Sekyere District). The main farming practices are mixed cropping (67 percent), Mono cropping (7 percent), crop rotation (4 percent), mixed farming (19 percent) and Agroforestry (3 percent), with the average number of farms per farmer and farm size being 1.2 and 1.23 Ha respectively (MOFA, Afigya Sekyere District).

The Industrial sub-sector is mainly small scale with activities centred on agro-based, wood-based, metal-based and textile-based (www.ghanadistricts.com, accessed March 12, 2009). Also, the commercial sector in the district is made up of mainly the informal sector which comprises of hairdressers, tailors, barbers, drivers, painters and so on (www.ghanadistricts.com, accessed March 12, 2009). The services of the informal sector are complimented by the formal sector through the services provided by the District Assembly and other government organisations such as the police and the courts.

3.1.1.4. Capsid and Cocoa Production

According to the Ministry of Agriculture in the district, about 7000 farmers are engaged in the production of the crop, thus it is a major cash crop and an important source of employment in the district. It is also estimated that about 20,000 hectares of cocoa farms in the district are affected by capsid; with the actual hectarage sprayed against capsid in the district to be 18,000 annually using a spraying gang of 45 people (MOFA, Afigya Sekyere District). The maximum number of times sprayed per farm is twice.

3.1.2. Sekyere West Municipality

The municipality is located in the northern part of Ashanti Region and shares boundaries with Atebubu District to the north, Sekyere East to the east, Afigya Sekyere to the south and Ejura-Sekyeredumasi to the west, with a total land area of 2346km^2 (www.ghanadistricts.com, accessed March 12, 2009). It is located within longitudes 0.05 degrees and 1.30 degrees west and latitudes 6.55 degrees and 7.30 degrees north (City and Town Planning Department, Kumasi). According to the 2000 Population and Housing Census, the population as at the year 2000 was 143,206 with a population growth rate of growth rate of 1.3 percent (2000 Population and Housing Census). Also, females form 50.16 percent of the total municipal population whilst males constitute 49.84 percent, with a dependency ratio of 1.07. The total housing population is 15470 with an average household size of 5.3 (2000 Population and Housing Census). It has Mampong as its municipal capital.

3.1.2.1. Climate and Vegetation

The municipality is marked by a bimodal rainfall regime, with an average annual rainfall between 800mm and 1500mm (Ghana Meteorological Service, Kumasi). The major rainy season occurs between March and July, with the minor rainy season occurring between September and November. There is a short period of dryness between December and March followed by a desiccating harmattan. The average annual temperature is 27 degrees Celsius with mean monthlies ranging between plus 3 degrees Celsius to minus 5 degrees Celsius throughout the year (Ghana Meteorological Service, *op. cit*). The municipality lies within the semi-equatorial zone and has a forest reserve, Kogya Nature Reserve, with a total land area of 115 square kilometres (MOFA, Sekyere West Municipality).

3.1.2.2. Topography and Soil

The municipality is partly located on the Mampong Scarp, which runs across it in an East-West direction and rises from about 135 metres to the highest point of 2,400 metres above mean sea level (City and Town Planning Department, Kumasi). It is underlain by Pre-Cambrian rocks of the Birimean formation (www.ghanadistricts.com, accessed March 12, 2009). The Scarp is fairly drained by several streams and rivers, notably Afram, Sene, Sasebonso and Kyirimfa. The land is fertile for all farming activities because of its reserve nature and watery state (MOFA, Sekyere West Municipality).

3.1.2.3. Agricultural and Other Economic Activities

The municipality is primarily agrarian. It employs about 75 percent of the total economically active workforce (MOFA, Sekyere West Municipality). This can be attributed to its vast arable land and limited alternative employment opportunities. Major crops grown are yam, cassava, maize, tomato, and so on. Cash crops grown are cocoa, oil palm, citrus and so on.

3.1.2.4. Capsid and Cocoa Production

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In Sekyere West municipality, about 5000 farmers are engaged in the production of cocoa, with a total hectarage of 7428 (MOFA, Sekyere West Municipality). Out of this figure, it is estimated that about 7253 hectares are affected by the capsid bug. Also, almost all the estimated hectarage of cocoa farms affected by the bug is sprayed, with a spraying gang of about 196 people (MOFA, Sekyere West, *op. cit*).

3.2. Sources and Types of Data

The data used in the present study is mainly primary and the study period covers the 2006/2007 cocoa season. Also, the unit of analysis is the individual cocoa farmer in the study area. The area includes Afigya Sekyere, Sekyere Central and Sekyere West all in the Ashanti Region of Ghana. The sample size used in the study is 184 farmers and they are distributed as follows; Afigya Sekyere (60), Sekyere Central (77) and Sekyere West (47). Also, secondary data was obtained concerning the state of cocoa production and capsid as well as other relevant information concerning the study areas. These data were obtained mainly from the district level offices of the Ministry of Agriculture, the district assemblies and the World Wide Web.

3.3. Sampling Technique

The sampling procedure employed in this study is the multi-stage cluster random sampling. At the first level, three districts from the Sekyere area were randomly selected. These districts are Afigya Sekyere, Sekyere West and Sekyere Central. The Sekyere area included Sekyere West, Sekyere Central, Sekyere East and Afigya Sekyere.

At the second level, areas that are relatively important to cocoa production were selected from each district. This was done based on information received from the district level offices of the Ministry of Food and Agriculture. Out of this list one town/village was randomly selected. For Sekyere West, the town randomly selected was the Yonson area; Kwaman area for Sekyere Central and Wiamoase for Afigya Sekyere.

In selecting the farmers, that is the third level of the sampling procedure, announcements were made to cocoa farmers through public address systems (PAS) for a meeting in the selected towns/villages. The present study also made use of contacts already established by the local Ministry of Agriculture in contacting the farmers. A forum was then created in the selected towns/villages to serve as a platform where the project was introduced to the farmers. In these fora, discussions were undertaken about cocoa capsid and the need to control it. Here, the farmers were particularly encouraged to tell us their experiences on cocoa capsid. They were also encouraged to make suggestions concerning the factors they see as important and likely to influence them to use capsicide and spray right (twice or more). A simple random procedure was then used to select a sample size of 184 farmers for the project. This is distributed as follows; Afigya Sekyere (60), Sekyere Central (77) and Sekyere West (47).

As described above, multistage random sampling approach was employed because the cocoa farmers within the Sekyere area forms a cluster (that is, they cluster around the Wiamoase Area in the Afigya Sekyere district; the Yonso Area in the Sekyere West and the Kwaman Area in the Sekyere Central). Also, the sampling procedure was conducted at different levels. This sampling approach is very appropriate and convenient when a research covers a large study area and the geographic spread of the population is large (Walliman et al., 2001). Also, it is suitable when the target population shares some characteristics but is heterogeneous as possible, that is varying age, gender, wealth, social status among others (Walliman *et al., Ibid.*). Additionally, it is convenient when time and cost issues are constraint to the researcher (David *et al.,* 2004).

3.4. Method of Data Collection

The primary data, which pertained to the 2006/2007 cocoa season, were collected from the sampled cocoa farmers using structured questionnaires administered between June and August 2008. The questionnaire included both close and open ended questions. The closed ended questions were mainly for quantitative data; whilst the open ended questions were for qualitative data. Before starting the actual data collection, the questionnaire was pre-tested; enabling the modification of some of the questions which were either irrelevant to the theme of the study or out of context. Also, effort was made to ensure that the wording and sequence of questions were right. The data captured in the questionnaire are defined and described as follows:

- CAPUSE is the quantity of capsicide used per unit time (litres). It is a binary variable; it takes on a value 1, if the farmer used capsicide in the 2006/2007 cocoa season and 0 if the farmer did not.
- FREQSP is the frequency of spray of capsicide per season. It is a binary variable; it takes on a value 1, if the farmer sprayed capsicide twice or more and 0 otherwise.
- AGE denotes the age of the cocoa farmer (years). It is a continuous variable.
- GENDER denotes the gender of the cocoa farmer. It is a binary variable; it takes on a value 1, if the farmer is male and 0 otherwise.
- HHSIZE denotes the household size of the farmer. It is a continuous variable.
- FARMSZ is the farm size and it is measured in hectares. It is a continuous variable.
- EXTVT is extension visit to the farmer and whether they talk about cocoa capsid, especially chemical control of capsid. It is a binary variable; it takes on a value 1, if the farmer had extension visits and education in the 2006/2007 cocoa season and 0 otherwise.
- FARMEXP is the farming experience of the farmer and it is measured in years. It is a continuous variable.
- FARMOW denotes whether the farmer owns the cocoa farm or not. It is a binary variable; it takes on a value 1, if the farmer owns farm and 0 otherwise.
- ENGOTHER denotes whether the cocoa farmer engages in other economic activities apart from cocoa production. It is a binary variable; it takes on a value 1, if the farmer engages in other economic activity and 0 otherwise.
- MEMFGP represents whether the cocoa farmer belongs to any farmers' group or

not. It is a binary variable; it takes on a value 1, if the farmer belongs to a farmer's group and 0 otherwise.

- FARMEDU is the farmer's educational level in years. It is a continuous variable.
- ACCDT denotes access to credit. It looks at whether or not the farmer has ever obtained credit in his/her locality? It is a binary variable; it takes on a value 1, if the farmer has ever obtained credit and 0 otherwise.
- EXFOOD denotes expenditure on food provided for farm labour. It is a continuous variable and it is measured in Ghana Cedis.
- INPUTSA denotes input shop availability in farmer's locality. It looks at the question of whether input shops are available in farmer's locality or not. It is a binary variable; it takes on a value of 1, if the farmer has inputs shop in his locality and 0 otherwise.
- BENMS is mass spraying and it represents whether or not the farmer has benefitted from mass spraying. It is a binary variable; it takes on a value of 1, if the farmer has benefitted from it and 0 otherwise.

3.5. Method of Data Analysis

Following data collection, the data were coded and entered into SPSS Version 16 computer software and used together with STATA 9 computer software for analysis. SPSS was chosen because of its appropriateness to be used in coding and entering of qualitative data for analysis as well as its ability to handle large data sets. Also, STATA 9 is easy to use and efficient in analysing qualitative response models.

Analytical techniques applied includes: cross-tabulations, pie charts, histograms, central tendencies (means) and measures of dispersion (standard deviation) as well as binary regression models (Tobit, Probit and Bi-Probit models).

3.6. Scope of the Research

The study seeks to analyse the cocoa farmer behaviour concerning the chemical control of capsid in the Sekyere Area, Ashanti Region, Ghana. It is therefore limited to the Sekyere Area, including the Sekyere West, Sekyere Central and Afigya Sekyere, to ensure in-depth analysis of theme of the study.

3.7. Limitations of the Study

The present study has identified and quantified the effects of the cocoa farmer socioeconomic and demographic characteristics on the use and frequency of spray of capsicide. However, there were a number of limitations faced by the researcher whose resolution can improve on the results of the study. First, there is fairly low variation in some of the socioeconomic characteristics across the individual cocoa farmers, as captured by the coefficient of variation (Table 4.1). This might have contributed to the insignificance of some of the coefficient of some of the variables even at 10 percent. Future studies can consider increasing the sample size of the study. Secondly, future research should check for multicollinearity in the models used in the study. Some of the coefficients in the models have insignificant values even at the 10 percent level and signs contrary to their expectations. Again, a possible solution is to increase the sample size of the study (Maddala, 2001).

3.8. Theoretical Framework

It is assumed that cocoa farms in the present area of study have been already established. The operations on the farm therefore are to control pests and diseases, as well as conduct cultural farm operations, among others. It is further assumed that cocoa producers in the Sekyere Area are rational producers and seek to minimise their cost concerning cocoa production subject to their output level constraints as follows:

Mininmise:

$$C = \sum_{j=1}^{n} w_j x_j \quad , n = 5 \tag{1}$$

subject to

$$f\ (x_1 \ldots\ldots\ldots\ldots\ldots\ldots x_m) = y^0 \quad , \ m = 6 \tag{2}$$

where C denotes cost of production of cocoa, w_j denotes the jth factor price, x_j denotes the jth factor inputs, and y^o denotes the parametric cocoa output constraint.

The factor inputs used in the production of cocoa, in this proposed study, comprises the following:

1. quantity of insecticide used in controlling Capsid (denoted as x_1),
2. chemicals used in controlling Blackpod and other diseases and pests (denoted as x_2),
3. labour used in controlling Capsid (denoted as x_3),
4. labour used in controlling Blackpod and other diseases (denoted as x_4),
5. labour used in performing other farm operations (denoted as x_5),
6. management (denoted as x_6).

Notably, x_6 is captured by a multiplicative vector of the socio-economic and demographic characteristics of the cocoa producer. The demographic characteristics are: age (AGE), gender (GENDER), and household size (HHSIZE). The socioeconomic characteristics are: extension visit (EXTVT), farming experience (FARMEXP), farm size (FARMSZ), farmer's engagement in other economic activities (ENGOTHER), membership of farm group (MEMFGP), Farmer's education (FARMEDU), access to credit (ACCDT), existence of input shop in farmer's locality (INPUTSA), farm ownership (FARMOW), expenditure on farm labour's food (EXFOOD), beneficiary of mass spraying (BENMS), and output level.

The Langrangian function (L) employed, with λ denoted as the Langrangian multiplier is stated as follows:

$$L = \sum w_j\, x_j + \lambda\, (y^0 - f\,(x_1, \ldots\ldots\ldots\ldots, x_6\,) \qquad (3)$$

The first order conditions (FOC) for minimisation obtained from differentiating the Langrangian function with respect to the factor inputs are as follows:

$$L_j \;= w_j \,-\lambda\; f_j \;\; = 0\;, \qquad\qquad j = 1, 2, \ldots\ldots, 5 \qquad (4a)$$

$$L_\lambda \;= y^0 \,-\, f\,(x_1, \ldots\ldots\ldots, x_6\,) \;= 0 \qquad (4a)$$

The sufficient second order condition (SOC) for minimisation is that the relevant Boarded Hessian Determinant should be positive definite (Silberberg *et al.*, 2001).

The factor demand equations can thus be solved from the FOC by invoking the *Implicit Function Theorem* (Silberberg *et al.*, 2001). It states that if the determinant of the first partials of a system of equations is nonzero, those equations can be solved, locally for those variables being differentiated as explicit functions of the remaining variables (parameters) of the system (Silberberg *et al., op cit.*). The Boarded Hessian is such a determinant and it is nonzero and in fact negative by the sufficient second order condition for minimisation.

Therefore, equations (4a) and (4b) can be solved for the relevant factor demand equations. They are given by equations (5) and (6);

$$x_j = f(w_1, w_2, ..., w_5, x_6, y^o) \quad , j = 1, 2, ..., 5 \tag{5}$$
$$\lambda = f(w_1, w_2, ..., w_5, x_6, y^o) \tag{6}$$

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The theoretical framework on the frequency of spray (twice or more) of capsicide by cocoa farmers per season, in the Sekyere Area is the same as outlined above for the quantity of use of capsicide per season.

The relevant *apriori* effects are as follows: $\partial x_j / \partial w_k < 0$ for j = k, $\partial x_j / \partial w_k > 0$ if the input k is substitutable to j and $\partial x_j / \partial w_k < 0$ if the input k is complementary to j. $\partial x_j / \partial y^o > 0$.

3.9. Statement of Hypotheses

In the present study, it is hypothesised that the socioeconomic and demographic characteristics of the cocoa farmer influences him/her concerning the frequency of spray (twice or more) of capsicide in the chemical control of capsid in the Sekyere Area, Ashanti, Ghana. It is also, hypothesised that the socioeconomic and demographic characteristics of the cocoa farmer influences him/her to use capsicide per season.

The working hypotheses for the present study are:

- Age (AGE) is expected to have a negative effect on capsicide use per season. As farmers grow older, there is an increase in risk aversion. The opposite is true for younger farmers who are still in the process of learning the best method for the management of their farms. Adesina and Zinnah (1993) found age to be negatively correlated with adoption.

- Household size (HHSIZE) is expected to have a positive effect on capsicide use per season. This variable is a measure of the availability of labour, especially family labour. Availability of labour is a potential factor in positively influencing the farmer to adopt an agricultural technology. Household size is found to be positively correlated to integrated pest management adoption (Bonabana, 1998).
- Farm size (FARMSZ) is expected to have a positive effect on capsicide use per season. Farm size is an indicator of wealth. Thus, it enables the farmer to bear more risk and encourage the adoption of new technologies. Also, farmers with larger farms invest more into information acquisition and accumulate knowledge that leads to adoption (Feder and Slade, 1984).
- Farmer's education (FARMEDU) is expected to have a positive effect on capsicide use per season. It increases the farmer's ability to understand and respond to information concerning new technologies (Feder and Slade, 1984). It is a continuous variable.
- Gender (GENDER), and for the present study being a male farmer, is also expected to have a positive effect on capsicide use per season. It is a dummy variable.
- Extension visits (EXTVT) to talk about chemical control of capsid is expected to raise the level of awareness of farmers concerning capsid, its devastating effects, its control, among others. Feder and Slade (1984), indicates that given that technology is profitable, increased information induces its adoption. According to

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Tovignan et al., (2004), extension visit exerts a positive and significant influence on the likelihood of the farmer adopting organic cotton in Benin. Therefore, extension visit to talk about chemical control of capsicide, it is expected to exert a positive effect on the use of capsicide per season in the present study. It is a dummy variable.

- Cocoa farming experience (FARMEXP) is expected to have a positive effect on capsicide use per season. This is because the more experience the farmer has in cocoa farming, the more they will become aware of the insect pest and its effects, especially if his/her farm has been affected before by capsid, all things being equal. Tovignan et al., (2004), found farming experience to exert a positive and significant influence on the likelihood of a farmer adopting organic cotton in Benin. It is a continuous variable.
- Farm ownership (FARMOW) Farm ownership is very important in the decision making process of the cocoa farmer regarding the use of capsicide. Depending on the tenancy agreement between the land owner and the tenant farmer, the tenant gets half or one-third of the farm output in the case of 'abunu' and 'abusa' respectively. There will therefore be a greater incentive to use capsicide when the farm is farmer owned. It is hypothesised in the present study that farm ownership (farmer owned) exerts a positive influence on the use of capsicide.
- Engaging in other economic activities (ENGOTHER) is expected to have a positive effect on capsicide use per season. It is expected to increase the income level of farmers so that they can buy more capsicide for use, all things being equal. Tovignan et al, (2004), found off-farm income to exert a significant positive influence on the adoption of organic cotton in Benin. It is a dummy variable.

- Membership of a farmers' group (MEMFGP) is expected to exert a positive effect on capsicide use per season. Farmers' group offer the opportunity for farmers to share ideas and experiences. They become more aware of capsid and its devastating effect through learning from each other. Hattam et al, (undated), found out that membership of farmers' association is statistically significant and exerts a positive influence on the adoption of certified organic production in Mexico. It is a dummy variable.
- Access to credit (ACCDT) is expected to have a positive effect on the use of capsicide per season. This is because, the more the farmer has access to credit the more he will be in a position to buy and use capsicide through the increased funds available to him for use, all things being equal. Ouma et al., (2002) and Degu et al., (2000), found access to credit to exert significant positive influence on the adoption of improved maize seed and fertilizer respectively.
- Input shop availability (INPUTSA) in farmer's locality is expected to have a positive effect on capsicide use per season. Karanja et al., (1998), using a cross-sectional data from Kenya, found out that the distance from the farm to the fertilizer market adversely affects the adoption and intensity of use of fertilizer. Input shop availability in a farmer's locality is therefore expected to exert a positive influence on the use of capsicide. This is because, given that funds are available to the cocoa farmer, capsicide will become available for purchase and use. It is a dummy variable.
- Expenditure on food for farm labour (EXFOOD) is also expected to have a negative effect on capsicide use per season. This is a cost to the farmer. Given that the farmer is rational and aims at minimising cost (optimising profit), increased EXFOOD associated with the use of capsicide will have a negative impact on the

probability of the farmer using capsicide, *ceteris paribus*.

- Benefiting from mass spraying (BENMS) is expected to have a negative effect on capsicide use per season. If farmers benefit from the mass spraying exercise, they will not attach much importance to complementing what is done for them, *ceteris paribus*. It is a dummy variable.
- Output (OUTPUT) is expected to have a positive effect on the use of capsicide by the cocoa farmer. This is so because the higher it is, the higher will be the cocoa farmer's income, all things being equal. It therefore improves the farmer's position to buy capsicide for use through the income effect from increased cocoa output.

The above apriori effects of socio-economic and demographic factors on the quantity of use of capsicide per season also holds for the frequency of spray (twice or more) of capsicide per season.

3.10. Empirical Analysis

Following the theoretical foundation, the empirical model in the present study of farmer's behaviour concerning the use (CAPUSE) of capsicide per season and the frequency of spray (FREQSP), twice or more, of capsicide is based on equations (6) and (7) respectively.

$$\begin{aligned} CAPUSE_{i1} &= \beta_0 + \beta_2 AGE_{i1} + \beta_3 GENDER_{i1} + \beta_4 HHSIZE_{i1} + \beta_5 FARMSZ_{i1} \\ &+ \beta_6 EXTVT_{i1} + \beta_7 FARMEXP_{i1} + \beta_8 FARMOW_{i1} + \beta_9 ENGOTHER_{i1} \\ &+ \beta_{10} MEMFGP_{i1} + \beta_{11} FARMEDU_{i1} + \beta_{12} ACCDT_{i1} + \beta_{13} INPUTSA_{i1} \\ &+ \beta_{13} EXFOOD_{i1} + \beta_{14} BENMS_{i1} + e_{i1} \end{aligned} \quad 6)$$

$$
\begin{aligned}
FREQSP_{i2} = {} & \alpha_0 + \alpha_2 \, AGE_{i2} + \alpha_3 \, GENDER_{i2} + \alpha_4 \, HHSIZE_{i2} + \alpha_5 \, FARMSZ_{i2} \\
& + \alpha_6 \, EXTVT_{i2} + \alpha_7 \, FARMEXP_{i2} + \alpha_8 \, FARMOW_{i2} + \alpha_9 \, ENGOTHER_{i2} \\
& + \alpha_{10} \, MEMFGP_{i2} + \alpha_{11} \, FARMEDU_{i2} + \alpha_{12} \, ACCDT_{i2} + \alpha_{13} \, INPUTSA_{i2} \\
& + \alpha_{13} \, EXFOOD_{i2} + \alpha_{14} \, BENMS_{i2} + e_{i2} \qquad (7)
\end{aligned}
$$

where the variables are already defined, and e_{i1} and e_{i2} are stochastic disturbance terms. They are assumed to be normally distributed, that is zero means and variance of 1, [redacted]e_{i1}, e_{i2} ~ [redacted]$,0,1,1,$. The variable, output, is eliminated from the empirical models to avoid the possible misspecification of the models. This is so because, output can have an influence on capsicide use and frequency of spray, through the higher incomes they generate. At the other end, using capsicide at the optimal spray can also induce increased outputs, *ceteris paribus*.

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To account for simultaneity and contemporaneous correlation of the error terms in equations (5) and (6), that is e_{i1} and e_{i2} respectively, and to obtain consistent and efficient estimates, a Bivariate Probit model is used (see for instance Aradhyula *et al.*, 2003) to estimate equations 6 and 7 simultaneously. It thus captures the simultaneous effect of the socioeconomic and demographic characteristics of the cocoa farmer in the Sekyere area and how it influences the farmer's decision concerning the use and frequency of spray of capsicide per season. The Bivariate Probit is specified as;

$$
\begin{aligned}
Z_{i1} = {} & \beta_0 + \beta_2 \, AGE_{i1} + \beta_3 \, GENDER_{i1} + \beta_4 \, HHSIZE_{i1} + \beta_5 \, FARMSZ_{i1} + \beta_6 \, EXTVT_{i1} \\
& + \beta_7 \, FARMEXP_{i1} + \beta_8 \, FARMOW_{i1} + \beta_9 \, ENGOTHER_{i1} + \beta_{10} \, MEMFGP_{i1} \\
& + \beta_{11} \, FARMEDU_{i1} + \beta_{12} \, ACCDT_{i1} + + \beta_{13} \, INPUTSA_{i1} + \beta_{13} \, RRUWAGE_{i1} \\
& + \beta_{14} \, BENMS_{i1} + e_{i1} \qquad (8)
\end{aligned}
$$

$$Z_{i2} = \alpha_0 + \alpha_2 AGE_{i2} + \alpha_3 GENDER_{i2} + \alpha_4 HHSIZE_{i2} + \alpha_5 FARMSZ_{i2} + \alpha_6 EXTVT_{i2}$$
$$+ \alpha_7 FARMEXP_{i2} + \alpha_8 FARMOW_{i2} + \alpha_9 ENGOTHER + \alpha_{10} MEMFGP_{i2}$$
$$+ \alpha_{11} FARMEDU_{i2} + \alpha_{12} ACCDT_{i2} + + \alpha_{13} INPUTSA_{i2} + \alpha_{13} RRUWAGE_{i2}$$
$$+ \alpha_{14} BENMS_{i2} + e_{i2} \quad (9)$$

$$Z_{i1} = 1 \; if \; CAPUSE_{i1} = 1, \quad Z_{i1} = 0 \; if \; CAPUSE_{i1} = 0$$
$$Z_{i2} = 1 \; if \; FREQSPS_{i2} = 1, \; Z_{i2} = 0 \; if \; FREQSP_{i2} = 0$$
$$\left[e_{i1}, e_{i2} \right] \sim \text{bivariate normal (BVN)} \left[0, 0, 1, 1, \rho \right]$$

Moreover, a Tobit model is used to capture the cocoa farmer's behaviour concerning only the use of capsicide, which is equation (6). Some farmers may not use insecticides (capsicide) to control Capsid. For this group in this study $CAPUSE_1$ is equal to zero. This is why the Tobit model is employed here. This has been used by other researchers in studying adoption behaviour of agricultural technologies in other crops (Degu *et al*., 2000; Oladede, 2003). Also, it is assumed that the frequency of spray of capsicide by cocoa farmers follows a normal distribution. Hence, a Probit model will be used to explain the cocoa farmer's behaviour concerning the frequency of spray of capsicide. Therefore, the empirical model for the frequency of spray of capsicide is based on equation (7).

The study employed qualitative response models (Tobit, Probit and Bi-Probit) because of the nature of the dependent variables, frequency of spray and capsicide use per year. These dependent variables takes on a limited number of discrete variables (in this case 1 or 0). Ordinary least square estimators will produce bias results (Maddala, 2001).

CHAPTER 4

4.0. RESULTS AND DISCUSSION

In this chapter, the results of the study are tabulated and discussed. First, a descriptive analysis of the variables used in the present study is presented. Here, the endogenous variables, frequency of spray and capsicide use per season, are first presented. This is followed by the respondents' characteristics and then other socioeconomic variables. Also, the results of the analysis of the empirical models in the present study are presented and discussed.

Table 4.1. Variable Definition and Sample Statistics

Variable	Definition	Mean	SD	Min	Max	COV
FREQSPRAY	Frequency of Spray	2.00	1.24	1.00	5.00	0.62
CAPUSE	Capsicide use (litres/ha)	0.26	0.15	0.10	0.60	0.60
AGE	Age (years)	58.30	13.29	29.00	85.00	0.23
FARMEDU	Farmer's education (years)	8.10	4.75	0.00	16.00	0.59
HHSIZE	Household size	8.33	4.05	2.00	30.00	0.49
FARMEXP	Farming Experience (years)	19.68	12.31	1.00	50.00	0.63
EXFOOD	Expenditure on Food per Day	2.30	11.76	2.00	3.90	5.12
FARMSZ	Farm Size (Hectares)	2.47	2.27	0.41	14.99	0.92
OUTPUT	Output (62kg/bag)	6.49	9.70	1.00	45.00	1.49

Table 4.1. (cont.)

Variable	Definition	Mean	SD	Min	Max	COV
MEMFGP	Membership of Farmer's Group	0.67	0.47	0.00	1.00	0.70
INPUTSA	Input Shop Availability	0.63	0.49	0.00	1.00	0.78
GENDER	Gender	0.62	0.49	0.00	1.00	0.78
FARMOW	Farm Ownership	0.86	0.35	0.00	1.00	0.41
EXTVT	Extension Visit	0.61	0.50	0.00	1.00	0.81
ENGOTHER	Engagement in Other Economic Activity	0.75	0.44	0.00	1.00	0.59
BENMS	Beneficiary of Mass Spraying	0.54	0.49	0.00	1.00	0.91
ACCDT	Access to Credit	0.31	0.46	0.00	1.00	1.48

SD denotes standard deviation; COV denotes coefficient of variation; min and max denote minimum and maximum respectively.

Source: Survey Data, 2007

4.1. Descriptive Analysis of Endogenous Variables

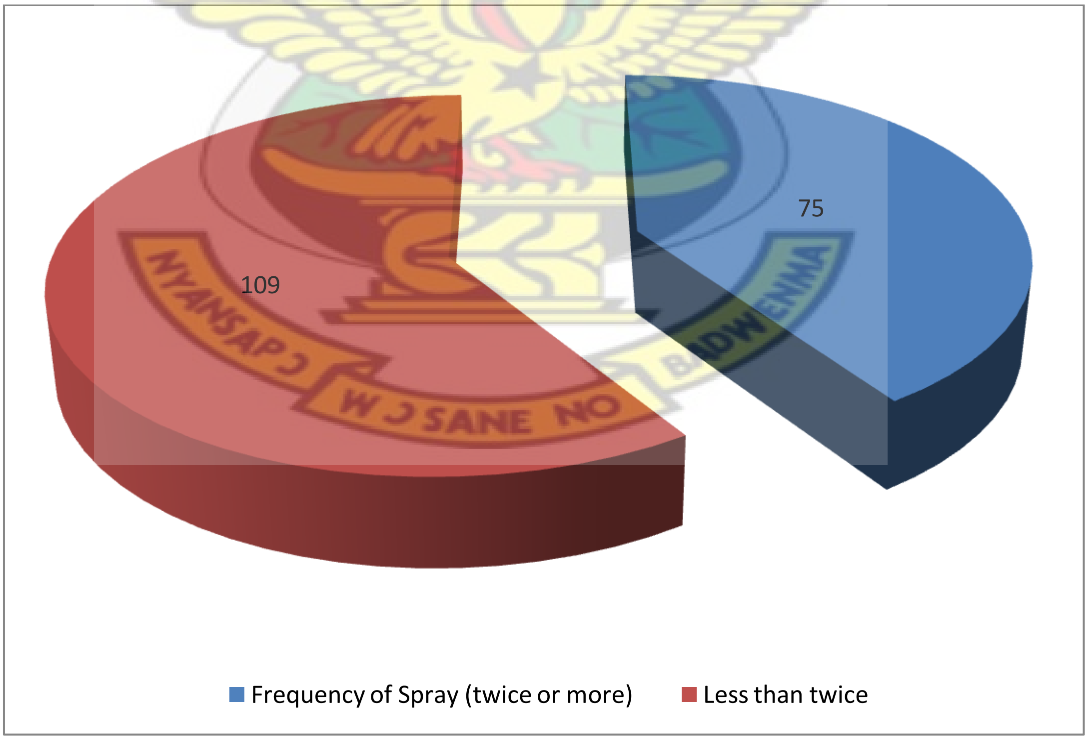
In this section, frequency of spray (twice or more) of capsicide in the 2006/2007 cocoa season by the cocoa farmer in the study area is first analysed and described. This is followed by the analysis and description of capsicide use by the cocoa farmer.

4.1.1. Frequency of Spray

With a sample size of 184 farmers, 109 farmers sprayed capsicide on their cocoa farms correctly (twice or more); whilst 57 farmers did not. A pie chart showing this distribution is shown in Figure 4.1. Also, from Table 4.1, the mean number of times farmers spray their farms against capsid is 2 per season.

The mean frequency of spray is very close to what is being done in the study area. For instance, the mean frequency of spray in the Afigya Sekyere district and Sekyere West Municipality are 3 and 2 per season respectively. However, the mean frequency of spray is not very close to what is recommended by experts to be effective against capsid that is four times in a season, from August to December. A number of reasons have been given by the farmers for this seemingly underspraying spraying regime. Among others are, lack of funds, input shop unavailability and lack of education concerning the proper way of applying the insecticide. The present study makes a major contribution to this problem by scientifically and empirically identifying the factors that are likely to influence the farmer to spray correctly.

Figure 4.1. A Distribution of Cocoa Farmers that Shows Frequency of Spray of Capsicide

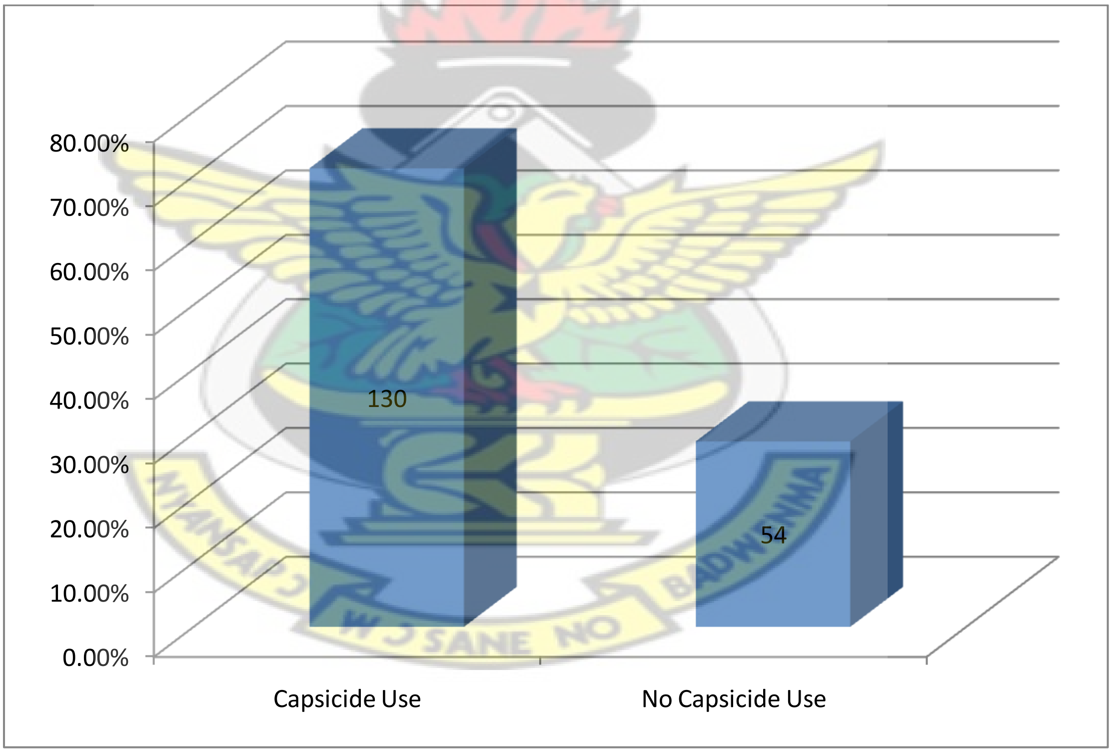


Source: Survey Data (2008)

4.1.2. Capsicide Use

From Figure 4.2, 130 cocoa farmers in the present study used capsicide in the 2006/2007 cocoa season but 54 did not. Of these farmers, almost all of them used Confidor SL (Akatemaster). The reason for the choice of this insecticide by the cocoa farmers is not very obvious. However, sources at the Ministry of Agriculture, Afigya Sekyere, say the insecticide is effective against the insect bug if sprayed well as to the quantity and number of times it should be sprayed; thus the name 'Akatemaster' which literally means the lord of all capsid.

Figure 4.2. A Distribution of Cocoa Farmers Showing Capsicide Use



Source: Survey Data (2007)

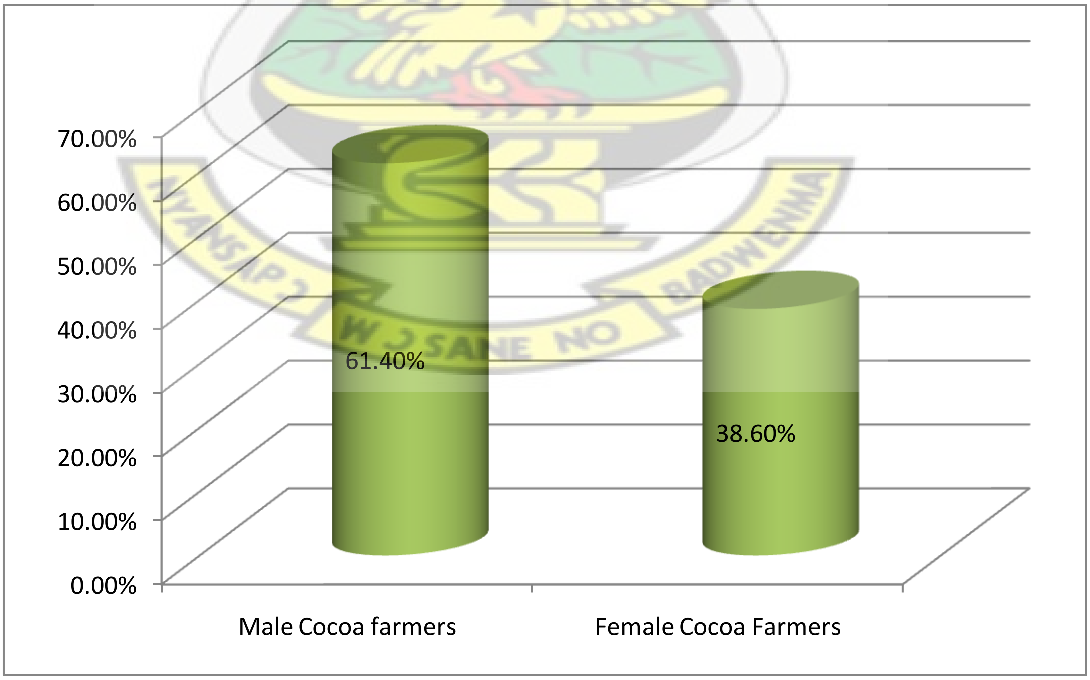
4.2. Respondent's Characteristics

Here, the farmer's characteristics are analysed and described using cross-tabulations, pie charts and histograms. It is satisfied as follows;

4.2.1. Gender

From the histogram shown in Figure 4.3, 113 (61.41 percent) of farmers in the study are males while 71 (38.59 percent) are females. The male farmers are therefore more than the female farmers in the study area. Though the survey could not establish any reason for this male dominance, the researcher believes that the drudgery and heavy cost initially involved in cocoa production favours the male cocoa farmer. The male cocoa farmer can take independent financial decisions unlike his female counterpart who most of the times consult with her household head before any decision is taken.

Figure 4.3. Gender Distribution of Cocoa Farmers



Source: Survey Data (2007)

4.2.1.1. Relationship between Gender and Frequency of Spray

According to the result from Table 4.2, 57.53 percent of male cocoa farmers sprayed twice or more whilst 42.47 percent did not. Also, with the female farmers, 61.98 percent sprayed twice or more, whilst 38.02 percent did not. There is an association between gender and frequency of spray, twice or more, shown by a chi-square value of 0.3575. However, this association is not significant even at the 10 percent level.

Table 4.2. The relationship between Gender and Frequency of Spray of Capsicide

Frequency of Spray / Gender	Less than Twice	Twice or More	Chi-square
Female, 71	**38.02%**	**61.98%**	0.3575
Male, 113	**42.47%**	**57.53%**	
Total	**75**	**109**	

***Source:** Survey Data (2007)*

4.2.1.2. Relationship between Gender and Capsicide Use

With regards to the use of capsicide (Table 4.3), out of a total of 113 male farmers, 69.92 percent used capsicide in the 2006/2007 cocoa season, whilst 30.08 percent did not. Moreover, out of a total of 71 female farmers, 52 used capsicide in the 2006/2007 cocoa season whilst 19 did not. The relation between gender and capsicide use by the cocoa farmer is not important in the present study. This is shown by a chi-square value of 0.2355 which is not significant even at the 10 percent level.

Table 4.3. The Relationship between Gender and Capsicide Use

Capsicide Use / Gender	Did Not Use Capsicide	Used Capsicide	Chi-square
Female, 71	**26.67 %**	**73.23%**	0.2355
Male, 113	**30.08%**	**69.92%**	
Total	**53**	**131**	

Source: Survey Data (2007)

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4.2.2. Age

From Table 4.1, the mean age of farmers in the present study is 58 years. The minimum age is 29 years with 85 years being the maximum age. This gives a range of 56 years. Fifty-five cocoa farmers fall within the age bracket 29 to 40 years, while 134 cocoa farmers fall within the age group 41 to 85. This distribution shows that cocoa farmers used in the present study are fairly old.

4.2.3. Farmer's Education

Farmer's level of education is very important and can be a factor in increasing the awareness level of capsid and the need to control it. From Table 4.1, the mean years farmers take to go to school is 8 years, with the minimum being 0 years and maximum 16 years. The farmers used in the study have not had much education. The survey could not give a reason to this. This is however expected given the many old farmers included in the survey.

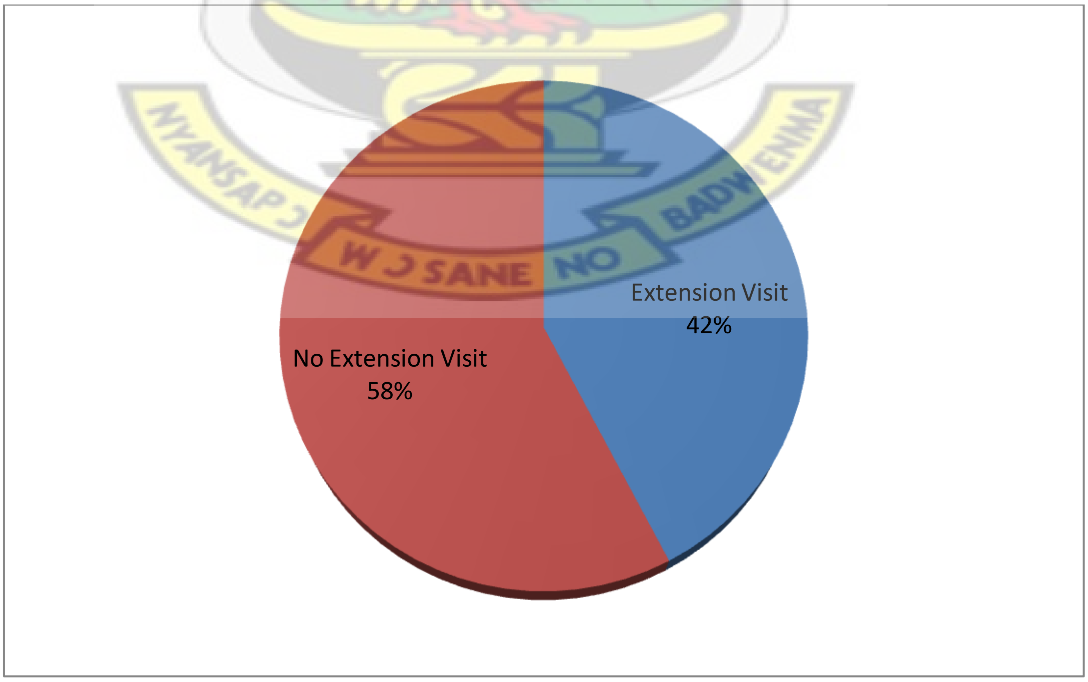
4.3. Socio-Economic Characteristics

In this section also, other factors (socio-economic) that are likely to influence the cocoa farmer to use capsicide and spray right are analysed.

4.3.1. Extension Visits and to Talk about Capsid

Extension is a means of making important cocoa information available to the cocoa farmer so that he can make informed decisions regarding the cultivation of the crop. Out of a total of 184 farmers, 78 (42.39 percent) had extension visits; whilst 106 (57.61 percent) did not (Figure 4.4). The survey showed that most of the farmers did not receive extension visits and education about capsid. This result is very much expected given the very low extension officers-farmer ratio in the study area. Despite this serious problem, extension officers are not resourced adequately and motivated enough to execute their duties.

Figure 4.4. A Distribution of Cocoa Farmers concerning Extension Visit



Source: Survey Data (2007)

4.3.1.1. Relationship between Extension Visit and Frequency of Spray

Of the 106 farmers who did not receive extension visits and education, 62.26 percent sprayed twice or more, whilst 37.74 percent did not (Table 4.4). Also, out of a total of 78 farmers who did receive extension visits, 55.13 percent sprayed twice or more, whilst 44.87 percent did not. A chi-square value of 0.9476 shows that that there is a relationship between extension visit and frequency of spray (twice or more). However, the relationship is not significant even at the 10 percent level.

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Table 4.4. The Relationship between Extension Visit and Frequency of Spray of Capsicide

Frequency of Spray / Extension Visit	Less than twice	Twice or more	Chi-square
No Extension Visit (106)	**37.74%**	**62.26%**	**0.9476**
Extension Visit (78)	**44.87%**	**55.13%**	
Total	**75**	**109**	

Source: Survey Data (2007)

4.3.1.2. Relationship between Extension Visit and Capsicide Use

Out of a total of 106 farmers who did not receive extension visit and education, 70.75 percent used capsicide in the 2006/2007 cocoa season, whilst 29.25 percent did not (Table 4.5). For the 78 farmers who did receive extension visit and education, 71.79 percent used capsicide and 28.21 percent did not. There is no significant association between extension visit and capsicide use by the cocoa farmer. This is because of a chi-square value of 0.0237, which is not significant even at the 10 percent level.

Table 4.5. The Relationship between Extension Visit and Capsicide Use

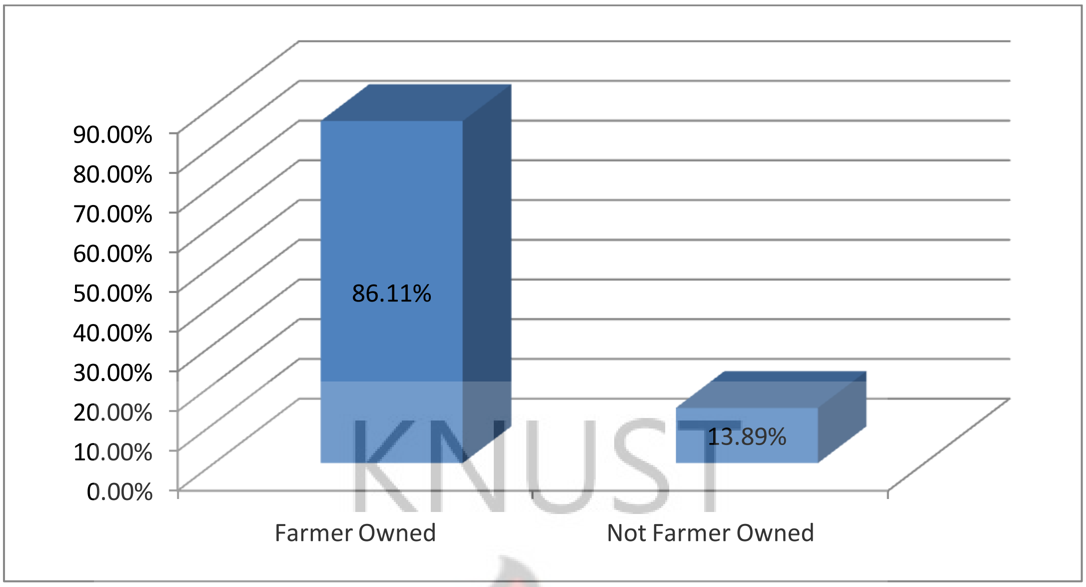
Capsicide Use / Extension Visit	Did Not Use Capsicide	Used Capsicide	Chi-square
No Extension Visit (106)	**29.25%**	**70.75%**	**0.0237**
Extension Visit (78)	**28.21%**	**71.79%**	
Total	**53**	**131**	

***Source:** Survey Data (2007)*

4.3.2. Farm Ownership

Farm ownership is very important in the decision making process of the cocoa farmer regarding the use of capsicide. It is intuitively plausible that all the benefits (increased output) from the use and optimal spray of capsicide get to the farmer when the farm is farmer owned. Depending on the tenancy agreement between the land owner and the tenant farmer, the tenant gets half or one-third of the farm output in the case of 'abunu' and 'abusa' respectively. There will therefore be a greater incentive to use capsicide when the farm is farmer owned. In the present study, 155 (86.11 percent) of the cocoa farmers owned their farm whilst 25 (13.89 percent) did not (Figure 4.5).

Figure 4.5. A Distribution of Cocoa Farmers on Farm Ownership



Source: Survey Data (2007)

4.3.2.1. Relationship between Farm Ownership and Frequency of Spray of Capsicide

Out of 25 farmers who do not own their farms, 72 percent sprayed twice or more and 28 percent did not (Table 4.6). Also for the farmers owned their farms, 58.06 percent sprayed twice or more whilst 41.94 percent sprayed less than twice. A chi-square value of 1.7419, which shows association between farm ownership and frequency of spray of capsicide (twice or more) is not significant even at the 10 percent level. This means that, there is no significant relationship between farm ownership and frequency of spray (twice or more).

Table 4.6. The Relationship between Farm Ownership and Frequency of Spray of Capsicide

Frequency of Spray / Farm Ownership	Less than twice	Twice or more	Chi-square
Not Farmer Owned (25)	28%	72%	1.7419
Farmer Owned (155)	41.94%	58.06%	
Total	72	108	

Source: Survey Data (2007)

4.3.2.2. Relationship between Farm Ownership and Capsicide Use

With regard to the use of capsicide, out of a total of 155 farmers who owned their farms, 71.61 percent used capsicide in the 2006/2007 cocoa season and 28.39 percent did not (Table 4.7). For the 25 farmers who did not own their farms, 72 percent used capsicide and 28 percent did not (Table 4.7). A chi-square value of 0.0016 which is not significant even at the 10 percent level, shows that there is not a strong association between farm ownership and capsicide use.

Table 4.7. The Relationship between Farm Ownership and Capsicide Use

Capsicide Use / Farm Ownership	Did Not Use Capsicide	Used Capsicide	Chi-square
Not Farmer Owned (25)	28%	72%	0.0016
Farmer Owned (155)	28.39%	71.61%	
Total	51	129	

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4.3.3. Engagement in Other Economic Activity

Engagement in other economic activity is a means of increasing the income level of the cocoa farmer. When the farmer's income is increased through this medium, he will be in an advantageous position to buy enough capsicide and use as recommended, all things being equal. In the present study, 136 (74.32 percent) farmers engaged in other economic activities; whilst 47 (25.68 percent) did not (Figure 4.6).

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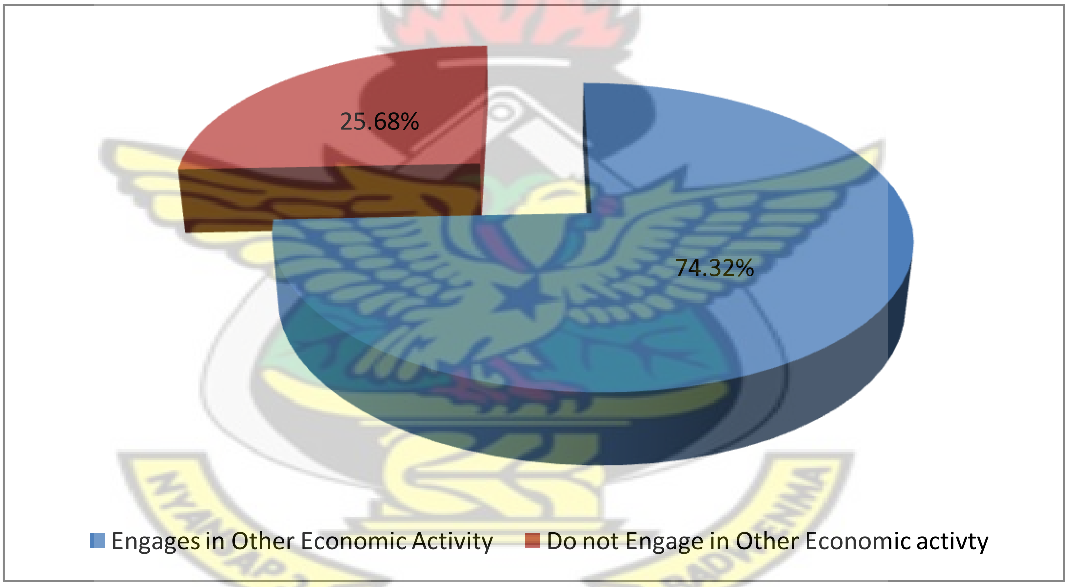
Figure 4.6. A Distribution of Cocoa Farmers Engaging in Other Economic Activity



Source: Survey Data (2007)

4.3.3.1. Relationship between Engagement in Other Economic Activity and Frequency of Spray of Capsicide

60.29 percent of the cocoa farmers that engage in other economic activities sprayed twice or more of capsicides on their farms whilst 39.71 percent sprayed less than twice (Table 4.8). Also, out of the 47 farmers who did not engage in other economic activities, 55.32 percent sprayed twice or more and 44.68 percent sprayed less than twice (Table 4.8). There is no strong relationship between engagement in other economic activity and frequency of spray (twice or more). This is shown by a chi-square value of 0.3574 which is not significant even at the 10 percent level.

Table 4.8. The Relationship between Engagement in Other Economic Activity and Frequency of Spray of Capsicide

Frequency of Spray / Engagement in Other Economic Activity	Less than twice	Twice or more	Chi-square
No Engagement in Economic Activity (47)	**44.68%**	**55.32%**	0.3574
Engages in Economic Activity (136)	**39.71%**	**60.29%**	
Total	75	**108**	

Source: Survey Data (2007)

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4.3.3.2. The Relationship between Engagement in Other Economic Activity and Capsicide Use

With 136 farmers who engaged in other economic activities, 77.21 percent used capsicide in the 2006/2007 cocoa season and 22.79 percent did not (Table 4.9). Also, out of the total of 47 farmers who did not engage in other economic activities, 30.09 percent used capsicide and 46.81 percent did not (Table 4.9). A chi-square value of 9.7907 is significant at the 1 percent level. This means that there is a strong relationship between engagement in other economic activity and use of capsicide by the cocoa farmer per year.

Table 4.9. The Relationship between Engagement in Other Economic Activity and Capsicide Use

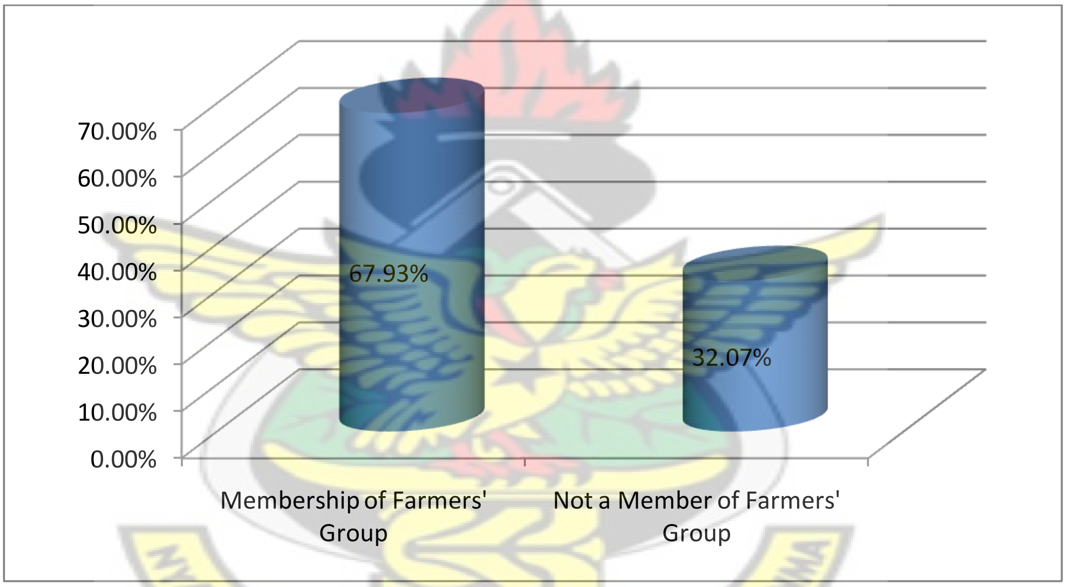
Capsicide Use / Engagement in Other Economic Activity	Did Not Use Capsicide	Used Capsicide	Chi-square
No Engagement in Economic Activity (47)	**46.81%**	**30.09%**	**9.7907***
Engages in Economic Activity (136)	**22.79%**	**77.21%**	
Total	**53**	**130**	

Source: Survey Data (2007)

4.3.4. Membership of Farmers' Group

Membership of farmers' group provides a new way to learn about cocoa and capsid by sharing common experiences among members. This awareness can help farmers make informed decisions regarding the control of cocoa capsid. In the present study, 125 farmers (67.93 percent) belonged to a farmers' group; whilst 59 farmers (32.07 percent) did not (Figure 4.7).

Figure 4.7. A Distribution of Cocoa Farmers on Membership of Farmers' Group



Source: Survey Data (2007)

4.3.4.1. Relationship between Membership of Farmers' Group and Frequency of Spray of Capsicide

Out of the 125 farmers who belonged to a farmers' group, 63.20 percent sprayed twice or more but 36.80 percent did not (Table 4.10). Again, with the 59 farmers who did not belong to a farmers' group, 50.85 percent sprayed twice or more whilst 49.15 percent did not (Table 4.10). There is no strong association between membership of farmers' group and frequency of spray (twice or more). This is because its chi-square value of 2.528 is not significant even at the 10 percent level.

Table 4.10. Relationship between Membership of Farmers' Group and Frequency of Spray

Frequency of Spray / Membership of Farm Group	Less than Twice	Twice or More	Chi-square
Not a Member of Farmers' Group (59)	49.15%	50.85%	2.5328**
Member of Farmers' Group (125)	36.80%	63.20%	
Total	75	109	

Source: Survey Data (2007)

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4.3.4.2. The Relationship between Membership of Farmers' Group and Capsicide Use

For the 125 farmers who belonged to a farmers' group, 65.60 percent used capsicide in the 2006/2007 cocoa season; whilst 34.40 percent did not (Table 4.11). Again, with 59 farmers who did not belong to a farmers' group, 83.05 percent used capsicide and 16.95 percent did not (Table 4.11). A chi-square value of 5.9520 which is significant at the 10 percent level, shows that there is a strong association between membership of farmers' group and capsicide use.

Table 4.11. The Relationship between Membership of Farmers' Group and Capsicide Use

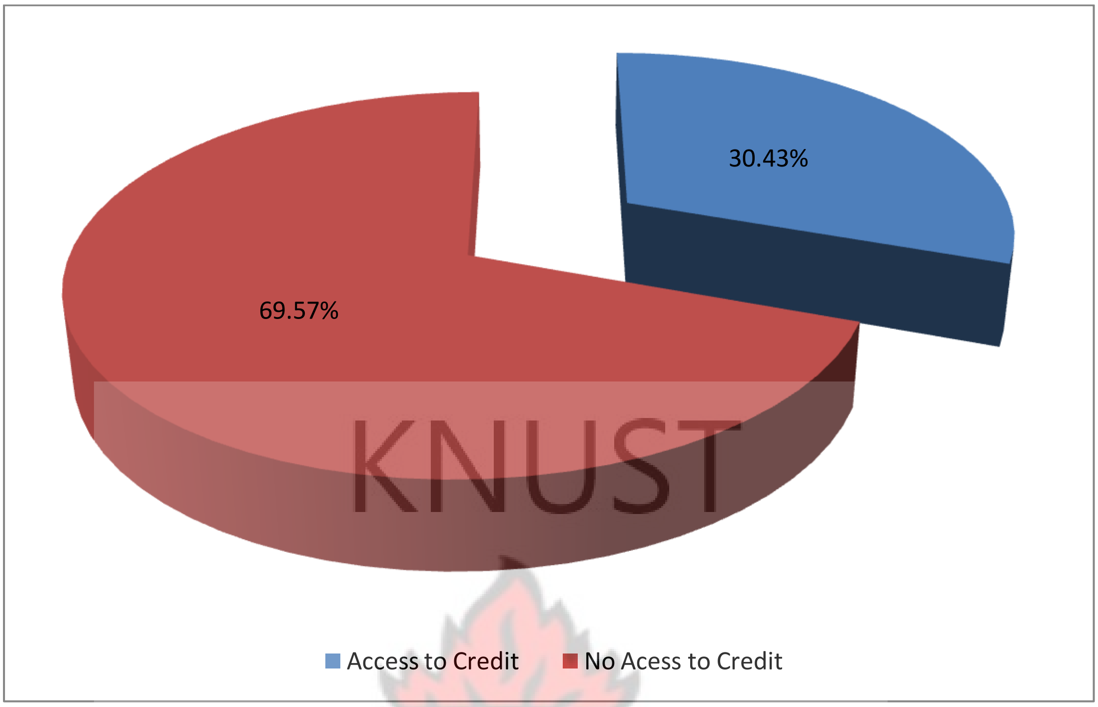
Capsicide Use / Membership of Farm Group	Did Not Use Capsicide	Used Capsicide	Chi-square
Not a Member of Farmers' Group (59)	16.95%	83.05%	5.9520***
Member of Farmers' Group (125)	34.40%	65.60%	
Total	53	131	

Source: Survey Data (2007)

4.3.5. Access to Credit

Access to credit (formal) is a potential means of increasing the purchasing power of the cocoa farmer. Therefore, when a farmer has access to credit he/she can be in a position to buy enough capsicide for use as recommended, all things being equal. For the present study, 128 farmers (69.57 percent) had no access to credit but 56 farmers (30.43 percent) had access to credit (Figure 4.8).

Figure 4.8. A Distribution of Cocoa Farmers on Access to Credit



***Source:* Survey Data (2007)**

4.3.5.1. Relationship between Access to Credit and Frequency of Spray of Capsicide

Fifty-six cocoa farmers had access to credit. Out of this number, 73.21 percent sprayed twice or more and 26.79 percent sprayed less than twice (Table 4.12). Also, out of a total of 128 farmers who had no access to credit, 53.12 percent sprayed twice or more and 46.88 percent sprayed less than twice (Table 4.12). There is a strong relationship between access to credit and frequency of spray (twice or more) of capsicide. This is explained by a significant chi-square value (6.511) at the 1 percent level.

Table 4.12. Relationship between Access to Credit and Frequency of Spray of Capsicide

Frequency of Spray / Access to Credit	Less than Twice	Twice or more	Chi-square
No Access to Credit (128)	**46.88%**	**53.12%**	**6.5111*** **
Access to Credit (56)	**26.79%**	**73.21%**	
Total	**75**	**109**	

Source:* *Survey Data (2007)

4.3.5.2. Relationship between Access to Credit and Capsicide Use

For the 56 farmers who had access to credit, 85.72 percent used capsicide in the 2006/2007 cocoa season whilst 14.29 percent did not (Table 4.13). Also, with the 128 farmers who had no access to credit, 64.84 percent used capsicide whilst 35.16 percent did not (Table 4.13). A chi-square value of 8.2744 shows a strong relationship between access to credit and capsicide use. The chi-square is significant at the 1 percent level.

Table 4.13. Relationship between Access to Credit and Capsicide Use

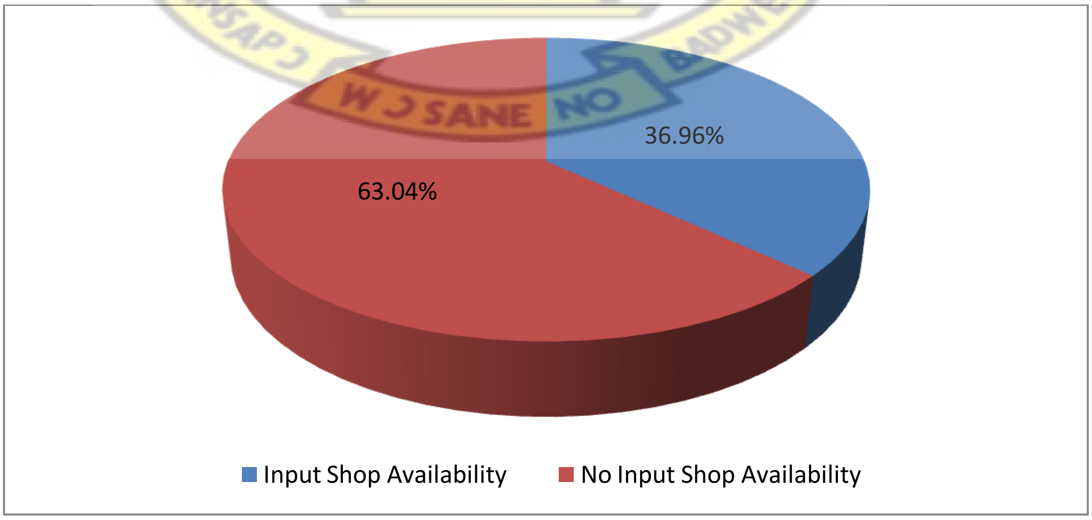
capsicide Use / Access to Credit	Did not Use Capsicide	Used Capsicide	Chi-square
No Access to Credit (128)	35.16%	64.84%	8.2744***
Access to Credit (56)	14.29%	85.72%	
Total	53	131	

Source: Survey Data (2007)

4.3.6. Input Shop Availability

Input shop in a cocoa farmer's locality is a way of making cocoa inputs such as capsicide, accessible to the cocoa farmer. This can save the farmer time and money which would have being used, if the input was bought in another town. 36.96 percent of the cocoa farmers had input shops in their locality, whilst 63.04 percent did not (Figure 4.9).

Figure 4.9. A Distribution of Cocoa Farmers on Input Shop Availability



Source: Survey Data (2007)

4.3.6.1. Relationship between Input Shop Availability and Frequency of Spray of Capsicide

With a total of 116 farmers who had input shops in their locality, 59.48 percent sprayed twice or more whilst 40.52 percent sprayed less than twice (Figure 4.14). Also, out of a total of 68 farmers who had no input shops in their locality, 58.82 sprayed twice or more whilst 41.18 sprayed less than twice. There is no strong association between input shop availability and frequency of spray (twice or more). This is because of a chi-square value (0.0077), which is not significant even at the 10 percent level.

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Table 4.14. Relationship between Input Shop Availability and Frequency of Spray of Capsicide

Frequency of Spray / Input Shop Availabity	Less than Twice	Twice or More	Chi-square
No Input Shop Availability (68)	**41.18%**	**58.82%**	**0.0077**
Input Shop Availability (116)	**40.52%**	**59.48%**	
Total	**75**	**109**	

Source: Survey Data (2007)

4.3.6.2. Relationship between Input Shop Availability and Capsicide Use

With 116 farmers who had input shops in their locality, 67.24 percent used capsicide in the 2006/2007 cocoa season whilst 22.76 percent did not (Table 4.15). Also, for the 68 farmers who had no input shops in their locality 77.94 percent used capsicide in the 2006/2007 cocoa season whilst 22.06 percent did not (Table 4.15). There is no strong association between input shop availability and capsicide use. This is explained by a chi-square value (2.3933), which is not significant even at the 10 percent level.

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Table 4.15. Relationship between Input Shop Availability and Capsicide Use

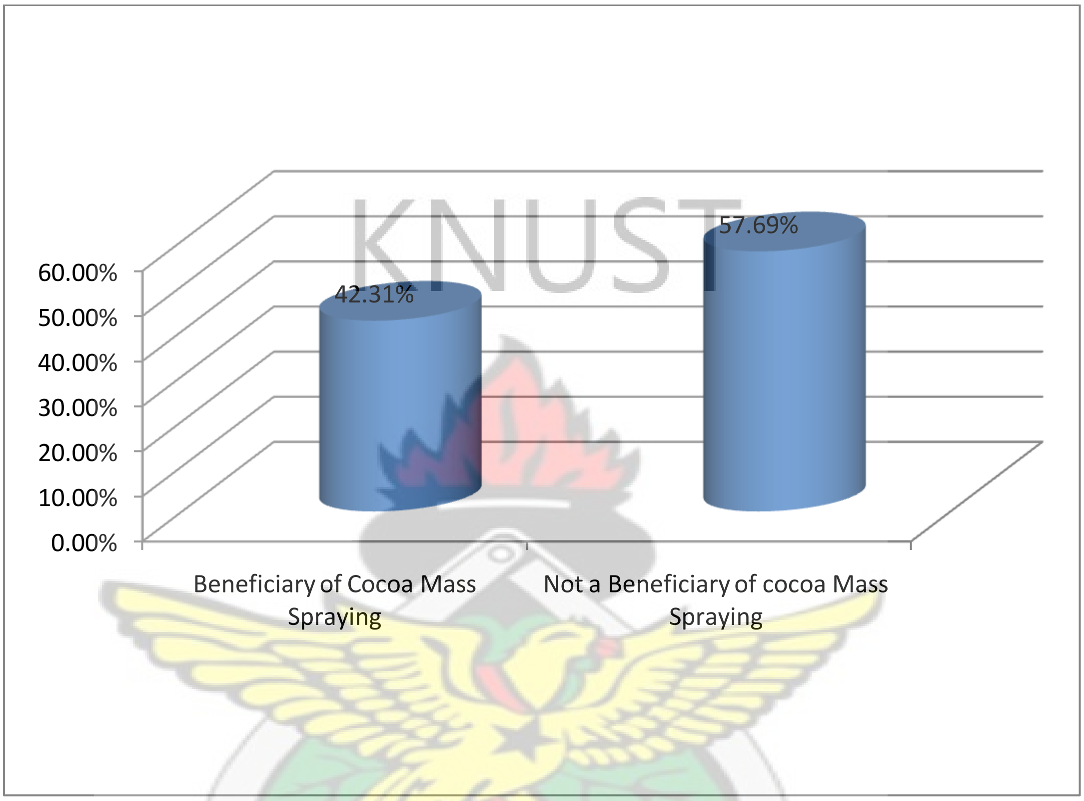
Capsicide Use / Input Shop Availabity	Did not Use Capsicide	Used Capsicide	Chi-square
No Input Shop Availability (68)	**22.06%**	**77.94%**	2.3933
Input shop Availability (116)	**22.76%**	**67.24%**	
Total	**53**	**131**	

Source: Survey Data (2007)

4.3.7. Beneficiaries of Cocoa Mass Spraying

Capsid is a very serious pest to cocoa. This fact has been noted by the government of Ghana, hence the institution of the Cocoa Disease and Pest Control Programme (CODAPEC), to spray cocoa farms nationwide against capsid and BlackPod. For the present study, 77 (42.31 percent) farmers have benefitted from the cocoa mass spraying programme and 105 (57.69 percent) farmers have not.

Figure 4.10. A Distribution of Cocoa Farmers on Beneficiary of Mass Spraying of Cocoa against Capsid



Source: Survey Data (2007)

4.3.7.1. Relationship between Beneficiary of Mass Spraying and Frequency of Spray of Capsicide

With the 77 farmers who benefitted from the programme, 58.44 percent sprayed twice or more whilst 41.56 percent sprayed less than 2 (Table 4.16). Again, out of a total of 105 farmers who did not benefit from the programme, 60 percent sprayed twice or more as against 40 percent who did not (Table 4.16). The association between beneficiary of CODAPEC and frequency of spray (twice or more) is not strong. This is explained by a chi-square value of (0.1285) which is not significant even at the 10 percent level.

Table 4.16. Relationship between Beneficiary of Mass Spraying and Frequency of Spray of Capsicide

Frequency of Spray / Beneficiary of Cocoa Mass Spraying	Less than twice	Twice or more	Chi-square
Not a Beneficiary (105)	40.00%	60.00%	0.1285
Beneficiary (77)	41.56%	58.44%	
Total	74	108	

***Source:* Survey Data (2007)**

4.3.7.2. Relationship between Beneficiary of Mass Spraying and Capsicide Use

With regards to the use of capsicide by the cocoa farmer in the 2006/2007 cocoa season, for the 77 farmers who benefitted from the programme, 71.43 percent used capsicide and 28.57 percent did not (Table 4.17). Also, with 105 farmers who did not benefit from the programme, 71.43 percent used capsicide and 28.57 percent did not (Table 4.17). The reported chi-square value of 0.0070 is not significant even at the 10 percent level. There is therefore no strong relationship between beneficiary of CODAPEC and capsicide use by the cocoa farmer.

Table 4.17. Relationship between Beneficiary of Mass Spraying and Capsicide Use

Capsicide Use / Beneficiary of Cocoa Mass Spraying	Did not use Capsicide	Used Capsicide	Chi-square
Not a Beneficiary (105)	**28.57%**	**71.43%**	**0.0070**
Beneficiary (77)	**28.57%**	**71.43%**	
Total	**52**	**130**	

Source: Survey Data (2007)

4.4. Empirical Analysis

Estimates of the parameters of the Tobit model concerning capsicide use is first presented and discussed. This is followed by the presentation and discussion of the estimates of the Probit model. Lastly, the results and discussions of the simultaneous Bi-Probit model and its marginal effects are presented.

4.4.1. Result of the Tobit Model

The results of the Tobit model estimation are shown in Table 4.18. From the results, it is seen that the coefficients of membership of farm group, engagement in other economic activity, output, access to credit and farming experience have positive signs as hypothesised. Access to credit, membership of farm group, output and engagement in other economic activity are all statistically significant at the 1 percent level, while farming experience is statistically significant at 5 percent.

Access to credit improves the financial position of the cocoa farmer, all things being equal. This therefore enables the cocoa farmer to purchase the right amount of capsicide for use. It exerts a positive and statistically significant effect on the probability of the cocoa farmer using capsicide a year. Therefore, the more access a farmer has to credit the greater the likelihood that the farmer will use capsicide. This result is consistent with results shown in studies conducted by Ouma et al, (2000) and Degu et al, (2002). They found out that access to credit exert significant influences on the adoption of improved maize seed and fertilizer respectively.

Moreover, farmers belonging to a farmers' group are able to share experiences concerning the insect pest. The information gained can raise the awareness level of the farmer with regard to how devastating the insect pest is and how to control it. It has a positive and statistically significant effect on the probability of the cocoa farmer using capsicide a year. Therefore, farmers' belonging to farmers' group are more likely to use capsicide on their cocoa farms against capsid. This is supported by literature on agricultural technology adoption (see for instance, Zegeye 2001 and Hattam et al, (undated)).

Also, engagement in other economic activity improves the financial position of the farmer, all things being equal. It therefore enables the cocoa farmer to buy capsicides for use through the income effect. This is supported by a study conducted by Tovignam et al, (2004). They found off-farm income to exert a significant positive influence on the adoption of organic cotton in Benin.

Farming experience tends to influence the cocoa farmer to use capsicide. Thus, the more experience cocoa farmer has in cocoa cultivation, the greater will be the probability of using capsicide. This is especially true when the cocoa farm has been attacked by capsid before. This is supported by Doss et al, (2003) and Tovignam et al, 2004. They found farming experience to exert influences on the use of improved technology and the adoption of organic cotton in Benin respectively.

Moreover, the coefficients of farm size, extension visit, farm ownership, household size, input shop availability and farmer's education are all positive as hypothesised but not significant even at the 10 percent level. Gender is significant at the 10 percent level and has the expected positive sign. Beneficiary of cocoa mass spraying (twice) has the expected negative sign but it is not significant even at the 10 percent level. Farmer's age and expenditure on food have positive signs contrary to what were expected and are not significant even at the 10 percent level.

There is fairly low variation in the farmers' characteristics concerning input shop availability, farm size, extension visit, farm ownership, household size and farmer's education level which might have contributed to their coefficients not been significant even at the 10 percent level (Maddala, 2001). The coefficient of variation statistic of each of the variables is given in Table 4.1. Also, a possible multicollinearity in the model can cause the coefficients in the model to be insignificant even at the 10 percent level and have signs contrary to their expectations (Maddala, Ibid).

A Log Likelihood Ratio test that coefficients on all the explanatory variables in both equations are zero is rejected at the 1 percent level of significance. This is based on a chi square value of 44.13 with a probability of 0.012. This shows that the coefficients of the explanatory variables are significantly different from zero. Thus, they exert influences on the use of capsicide by the cocoa farmer per season.

Table 4.18. Estimates of the Tobit Model.

Dependent Variable : CAPUSE

Variable	Coefficient	z-statistic
AGE	0.001	0.314
GENDER	0.180	1.970
FARMEDU	0.027	1.003
HHSIZE	0.007	0.785
EXTVT	0.120	1.312
FARMOWN	0.043	0.359
FARMEXP	0.007**	1.693
ENGOTHER	0.235***	2.207
MEMFGP	0.263***	2.891
ACCDT	0.322***	3.552
EXFOOD	0.002	0.580
INPUTSA	0.183	1.712
FARMSZ	0.004	0.548
BENMS2	-0.070	-0.724
OUTPUT	0.013***	2.495
Log likelihood	= -125.058	
Number of Observations	= 177	
R-square	= 0.206	
Wald Chi-square	= 44.13 (0.012)	

***denotes significance at the 1 percent level; ** denotes significance at the 5 percent level.

Source: Author's Computation

4.1.2. Result of the Probit Model

Table 4.19 shows that access to credit, membership of farmers' group and household size have positive impacts on the frequency of spray of capsicide by the cocoa farmer. Access to credit is significant at the 1 percent level, while household size and membership of farmers' group are significant at 5 percent level.

Farmer's access to credit and membership of farmers' group have positive effects on the frequency of spray of capsicide by the cocoa farmer per season. Thus, they tend to influence the cocoa farmer to spray correctly against capsid on their cocoa farms. The explanations for these observations are the same as that already provided for the capsicide use equation (Tobit Model).

Again, the higher the household size the higher the level of availability of family labour, all things being equal. Household labour is sometimes free of charge and thus saves the farmer money which can be used in other farm operations. Also, considering the fact that spraying of capsid on the cocoa farm is very difficult, the greater the household size of a cocoa farmer the more the farmer will spray against capsid correctly. It has a positive effect on the spray of capsicide by the cocoa farmer. Bonabana, 1998 found household size to exert a positive influence on integrated pest management adoption.

A Log Likelihood Ratio test that coefficients of all the explanatory variables in the equations are zero is rejected at the 10 percent level of significance. This is based on a chi square value of 22.19 with a probability of 0.058. It means that the explanatory variables have effects on the frequency of spray of capsicide (twice or more).

Farm size, engagement in other economic activity, farm ownership, farming experience and input shop availability all have positive effects on the likelihood of the farmer spraying twice or more as hypothesised. However, their effects are not significant even at the 10 percent level. Farmers' education is significant at the 10 percent level. Also, age, farmer's expenditure on food on farm labour and beneficiary of cocoa mass spraying (twice) have negative effects on the spray of capsicide (twice or more) but are not significant even at the 10 percent level. Gender and extension visit have negative effects contrary to their hypotheses.

The explanations for the insignificance (below the 5 percent level) of the coefficients of farm size, engagement in other economic activity, farming experience, farmers' education, input shop availability and farm ownership are the same as given for these variables under the Tobit model.

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Table 4.19. Estimates of the Probit Model

Dependent Variable : Capsicide Use

Variable	Coefficient	Z-statistic
AGE	-0.040	- 2.000
GENDER	-0.259	-1.073
FARMEDU	0.140	1.862
HHSIZE	0.059**	2.005
EXTVT	-0.257	-1.069
FARMOW	0.321	0.954
FARMEXP	0.006	0.599
ENGOTHER	0.002	0.010
MEMFGP	0.323**	1.354
ACCDT	0.569***	2.318
EXFOOD	-0.003	-0.407
INPUTSA	0.385	1.340
FARMSZ	0.015	0.600
BENMS2	-0.222	-0.861
OUTPUT	0.016	1.170

Log likelihood	= -93.092
Number of Observations	= 177
McFadden R^2	= 0.124
Chi-square	= 23.119 (0.058)

***denotes significance at the 1 percent level; ** denotes significance at the 5 percent level.

Source: Author's Computation

4.1.3. Result of the Bi-Probit Model

The results of the Bi-Probit model (Table 4.20), show that the coefficients of farming experience, engagement in other economic activities, output, membership of farmers' group, access to credit and input shop availability have the expected positive signs. Engagement in other economic activity, output, access to credit and membership of a farmers' group are all significant at the 1 percent level. Farming experience and input shop availability are significant at the 5 percent level.

Access to credit, output, engagement in other economic activity, membership of farmers' group and farming experience tend to influence the probability of the cocoa farmer using capsicide. Their explanations are the same as those already provided for the use of capsicide (Tobit Model). Moreover, when input shops are available within the farmers' locality, capsicides become available. Given that funds are available to a cocoa farmer, the farmer can buy the capsicide for use.

Moreover, in increasing order of magnitudes access to credit (23.5 percent), engagement in other economic activity (21.7 percent), membership of a farmers' group (21.6 percent), input shop availability and farming experience (0.7 percent) are the marginal impacts of the variables on the likelihood of the farmer using capsicide per season (Table 4.21). From these marginal impacts, access to credit offers the most impact on the probability of the cocoa farmer using capsicide.

Farmers' education, household size, extension visit, farm ownership, farm size have the expected positive signs but are not statistically significant even at the 10 percent level. Also, age has the expected negative sign but it is not statistically significant even at the 10 percent level. Gender and beneficiary of cocoa mass spraying have negative signs that are contrary to expectations. Explanation for these observations is the same as already given under the Tobit model.

For the frequency of spray equation, show that membership of farmers' group, access to credit and farmer's household size exert positive effects on the frequency of spray of capsicide twice or more by the cocoa farmer in the Sekyere Area as hypothesised. Access to credit is significant at the 1 percent level. Household size and farmer's education are all significant at 5 percent level.

Access to credit, membership of farmers' group and farmer's household size members tend to influence the cocoa farmer to spray correctly. Explanations for these observations are the same as those already provided for the frequency of spray of capsicide (Probit Model).

The result of Table 4.22, shows that access to credit (19 percent), membership of a farmer's group (15.2 percent), household size (1.8 percent) and farmers' education (4.1 percent) are marginal impacts (parentheses) on the probability of the farmer spraying twice or more. It can be seen from the marginal effects that access to credit gives the most marginal impact (19 percent) on the farmer spraying twice or more.

Gender, farm size, engagement in other economic activity, input shop availability and farming experience have positive effects on the likelihood of the farmer spraying twice or more against capsid as expected, but are not significant even at the 10 percent level. Age, farmer's expenditure on food and beneficiary of cocoa mass spraying have the negative impacts on the frequency of spray of capsicide as hypothesised, but are also not significant even at the 10 percent level. The coefficients of extension visit and farm ownership have negative signs and are not significant even at the 10 percent level. This is contrary to the positive signs expected. Again, explanation for these observations is the same as already provided under the Probit model.

A test that coefficients on all the explanatory variables in both equations are zero is rejected at the 1 percent level of significance. This is based on a Wald chi square value of 54.55 with a probability of 0.014. It means that the explanatory variables (socioeconomic and demographic factors) have effects on the use of capsicide by the cocoa farmer per season.

Table 4.20. Estimates of the Bi-Probit Model.

Variable	Frequency of Spray Equation		Ever Capsicide Use Equation	
	Coefficient	Z-stat.	Coefficient	Z-stat.
AGE	-0.015	-1.500	-0.013	-1.080
GENDER	-0.257	-1.130	-0.430	-1.660
FARMEDU	0.107	1.500	0.658	0.780
HHSIZE	0.047**	1.700	0.021	0.670
EXTVT	-0.221	-0.980	0.135	0.510
FARMOW	-0.417	-1.290	0.012	0.040
FARMEXP	-0.004	-0.370	0.025**	1.950
ENGOTHER	0.075	0.290	0.739***	2.620
MEMFGP	0.394**	1.750	-0.883***	-3.130
ACCDT	0.515***	2.210	0.894	3.020
EXFOOD	-0.001	-0.120	0.009	0.910
INPUTSA	0.384	1.400	0.605**	1.840
FARMSZ	0.008	0.340	0.014	0.410
BENMS2	-0.110	-0.470	-0.010	-0.040
OUTPUT	0.016	1.190	0.074***	3.010
Log likelihood	= -185.973			
Number of Observations	= 177			
Wald Chi-square	= 54.98 (0.022)			

***denotes significance at the 1 percent level; ** denotes significance at the 5 percent level.

Source: Author's Computation

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Table 4.21. Estimate of the Marginal effects

Dependent Variable: Capsicide Use

Variable	Marginal Effect[1]	Standard Error
AGE	0.004	0.003
GENDER	-0.117	-0.068
FARMEDU	0.018	0.024
HHSIZE	0.006	0.009
EXTVT	0.038	0.072
FARMOW	0.003	0.095
FARMEXP	0.007**	0.004
ENGOTHER	0.217***	0.096
MEMFGP	0.216***	0.059
ACCDT	0.236***	0.061
RRUWAGE	0.003	0.003
INPUTSA	0.179**	0.099
FARMSZ	0.004	0.010
BENMS2	0.003	0.079
OUTPUT	0.021***	0.006

[1] denotes (dy/dx); where y = CAPUSE and x = explanatory variables; ***denotes significance at the 1 percent level; ** denotes significance at the 5 percent level.

Source: Author's Computation

Table 4.22. Marginal effects

Dependent Variable: Frequency of Spray

Variable	Marginal Effect[1]	Standard Error
AGE	0. 006	0.004
GENDER	0.098	0.085
FARMEDU	0.041	0.027
HHSIZE	0.018**	0.011
EXTVT	-0.085	0.087
FARMOW	-0.151	0.108
FARMEXP	0.001	0.004
ENGOTHER	0.029	0.099
MEMFGP	0.152*	0.087
ACCDT	0.190***	0.081
EXFOOD	-0.000	0.003
INPUTSA	0.148	0.106
FARMSZ	0.003	0.009
BENMS2	0.042	0.091
OUTPUT	0.006	0.005

[1] denotes (dy/dx); where y = Frequency; x = explanatory variables; ***denotes significance at the 1 percent level; ** denotes significance at the 5 percent level.

Source: Author's Computation

CHAPTER 5

5.0. SUMMARY OF MAJOR FINDINGSAND POLICY RECOMMENDATION

5.1. Summary of Results

This study analysed the behaviour of the cocoa farmer concerning the chemical control of capsid in the Sekyere Area, Ashanti Region, Ghana. It has employed cross-tabulations, pictographs and tables to describe the distribution of the sample. Also, Tobit, Probit and a Bi-Probit models are used to estimate the quantitative effect of the socioeconomic and demographic characteristics of the cocoa farmer on the use and frequency of spray (twice or more) of capsicides per year. A number of interesting results are obtained from the study.

First, the results from the cross-tabulation analyses show that access to credit, engagement in other economic activity and membership of farmers' group exert statistically significant associations with the use of capsicide by the cocoa farmer per year. Again, membership of farmers' group and access to credit exert significant relationships with the frequency of spray of capsicide per year.

Second, the result of the Tobit model (Table 4.18) shows that membership of a farmers' group, engagement in other economic activity, output, access to credit and farming experience have positive signs as hypothesised. These variables therefore exert positive influences on the likelihood of the cocoa farmer using capsicide per year.

Third, the result of Probit model concerning the frequency of spray equation (Table 4.19) shows that household size, membership of a farmers' group and access to credit all have positive impacts on the frequency of spray of capsicide by the cocoa farmer. Increases in the level of these variables are therefore likely to influence the cocoa farmer to spray twice or more.

Fourth, the results of Bi-Probit model (Table 4.20) show that access to credit, input shop availability, farming experience, engagement in other economic activity and membership of farmers' group tend to influence the cocoa farmer to use capsicide per season. From Table 4.21, the marginal impacts of these variables on the probability of use of capsicide are: access to credit (23.5 percent), engagement in other economic activity (21.7 percent), farming experience (0.7 percent), membership of farmers' group (21.6 percent) and input shop availability (17.9 percent). From these marginal impacts, it can be seen that access to credit offers the most impact on the probability of use of capsicide by the cocoa farmer per season.

For the frequency of spray of capsicide equation household size, membership of farmers' group and access to credit are statistical significant and have positive signs as hypothesised. They therefore tend to influence the cocoa farmer to spray twice or more capsicides per season. Their marginal impacts in parentheses are as follows (Table 4.22): access to credit (19 percent), membership of farmers' group (15.2 percent) and household size (1.8 percent). Comparatively, access to credit offers the most marginal impact on the probability of the farmer spraying twice or more a year. A number of policy recommendations emanate from the empirical results.

5.2. Policy Recommendation

A number of policy recommendations emanates from the empirical results obtained from the study.

Firstly, a cocoa microfinance scheme can be established in the cocoa growing areas to make funds accessible to cocoa farmers. This proposed fund can be managed for by rural banks in the cocoa growing areas on behalf of the government. This will make funds available to the farmers for their farming operations, including the purchase of capsicide for use. When this is done and the farmers have access to credit, it is likely to influence them to use capsicide and spray correctly (twice or more). It is also important to take into consideration experiences of financial institutions and government financial interventions with regards to providing credit to farmers. There have been reported cases of farmers defaulting on the payment of their loan.

Secondly, the farmers should be encouraged to form groups. This can be done by enticing them with group loans and as well other government interventions such as fertilizers, cutlasses and other inputs. When such groups are formed, workshops, seminars and other such fora should be organised for them with competent resource personnel to teach them about capsid, its devastating effects and its control. All said and done, it can go a long way in shoring up cocoa production in the study area, all things being equal.

Thirdly, the government can encourage the setting up of input shops in the farmer's locality. Here, the government can provide tax incentives and holidays to private entrepreneurs to motivate them to set up input shops in farmers' localities. This will make inputs, such as capsicide available to the farmers for use.

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NYANSAPƆ WƆSANE NO BADWENMA

BACKGROUND INFORMATION

Serial Number………………………………………………………………………..

Date……………………………Time Start………………….End………………….

Town/Village…………………………..Location of Farm………………………….

House Number……………………………………………………………………

Administrative District……………………………………………………………

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Name of Farmer…………………………………………………………………….

Date of Birth………………………………………………………………………

A. COCOA PRODUCER CHARACTERISTICS

1. Gender ( ) Male ( ) Female
2. Age of Farmer (years)…………………………………………………………..
3. Marital Status ( ) Single ( ) Married ( ) Divorced ( )Widow ( )Widower
4. Number of children living in the house……………………………………………
5. Number of other dependents……………………………………………………….
6. Citizenship ( ) Native ( ) Migrant (Origin…………………………………)
7. Formal Education (years)…………………………………………………………….
8. Formal Education (type) ( ) None ( ) Primary ( ) Middle
   ( ) JSS ( ) SSS
   ( ) Secondary (GCE O'Level)
   ( ) Secondary (GCE A'Level)
   ( ) Technical ( ) Vocational

( ) Training College

( ) Polytechnic

( ) University

( ) Others (please specify…. ……………………..)

9. How many experience do you have in cocoa farming (years)?....………...

10. Do you belong to any farmer group? ( )Yes ( )NO

11. If yes, what is the name of the group?……………………………………

12. Does an extension officer live in your town/village? ……………………….

13. Does an extension officer visit your farm? ( ) Yes ( ) No

14. How many times does he visit you?..

15. Does he talk about Capsid or 'Akate'? ( ) Yes ( ) No

16. What kind of capsid information do you receive from the extension officer? Please tick:

( ) Chemical Control ( ) Cultural Control

( ) Biological Control ( ) None

17. Do you have a bank in your town/village? ( ) Yes ( ) No

18. If yes indicate the type of bank:

( ) Rural Bank

( ) Agricultural Development Bank

( ) Ghana Commercial Bank

( ) Others (please specify: ………………………………………

19. Do you save in a bank? ( ) Yes ( ) No

20. If yes, indicate the name of the bank……………and location………………..

21. If no, why not? Please explain…………………………………………………

22. Have you ever obtained credit in your district? ( ) Yes ( ) No

23. Did you use credit in the immediate past cocoa season? ( ) Yes ( ) No

23.a. If yes, from which source;

( ) Bank Name…………….. Amount……………

( ) Friends Amount………………………………......

( ) Money Lenders Amount……………………………….

( ) Family members Amount……………………………….

( ) Others Specify…………. Amount…………….

24. Are you engaged in other economic activities? ( ) Yes ( ) No

25. If yes, please specify………………………………………………………..

…………………………………………………………………………………

…………………………………………………………………………………

B. FARM CHARACTERISTICS

26. How many land holdings do you have?...................…………………………

27. How many are cocoa plots?...…………………

28. Size of cocoa farms (acres), please specify below

first plot…………………………………………………………………….

Second plot………………………………………………………………….

Third plot…………………………………………………………………….

Others (Please specify……………………………………………………….

28.a Farm Ownership (Plot 1): ( ) Owner ( ) Abunu Share Cropping

( ) Abusa Share Cropping

( ) Others (please specify)……………....

28.b. Farm Ownership (Plot 2): ( )Owner ( )Abunu Share Cropping

( ) Abusa Share Cropping

( ) Others (please specify)……………….

28.c. Farm Ownership (Plot 3): ( ) Owner ( )Abunu Share Cropping

( ) Abusa Share Cropping

( ) Others (please specify)………………

28.d. Farm Ownership (Other plots): ( ) Owner ( )Abunu Share Cropping

( ) Abusa Share Cropping

( ) Others (please specify)…………...

29. Output of cocoa farm (number of 62.5 kg bags):

First Plot (Major season 2006/2007)……………………………………………

First Plot (Minor season 2006/2007)……………………………………………

Second Plot (Major season 2006/2007)……………………………………..

Second Plot (Minor season 2006/2007)……………………………………….

Others (Major season 2006/2007)……………………………………………..

Others (Minor season 2006/2007)……………………………………………….

30. Is a cocoa input shop available in your town/village? ( ) Yes ( ) No

30.a If no, where do you buy your cocoa inputs?...

31. Did you benefit from Cocoa Mass spraying against capsid last year?

( ) Yes ( ) No

31.1. How many times did they spray your farm this season?............................

31.2. What is the farm area covered (acres)?..

31.3. What chemical did they use?..

31.4. What is the quantity of chemical used? ………………………………..

32. Do you control capsid on your farm? ( ) Yes ( ) No

32.1. What method do you use to control capsid?

- Cultural methods (please circle the appropriate frequency)

( ) Shade Adjustment (frequency:….1,...2,…3,….4,….5,…….,>5)

( ) Regular Weeding/brushing (frequency:..I,….2,…3,…….4,….5,….,>5)

( ) Prunning (frequency:…1,……..2,…….3,…….4,…….5,….,>5)

- Non-cultural methods (please circle the appropriate frequency)

( ) Chemical control of capsids (name the chemical used)……….........

(frequency:……1,……..2,…….3,…….4,…….5,…….,>5)

a. What quantity of chemical did you use?...

b. How many acres did you apply the chemical?....................................

33. What is your source of farm labour?

( ) Farmer

( ) Family Labour

( ) Co-operative (Nnoboa)

( ) Hired casual labour (wage per day……………………)

( ) Caretaker (wage per day………………………..)

( ) Contact labour (Wage per acre…………………)

34. Do you buy food for your hired labour:………………………………………

35. If yes, how much?...