The Impact of Mass Spraying Programme on Cocoa Production in Ghana.

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Abstract

The Government of Ghana has over the years been committed to implementing policy measures within the cocoa sub-sector such as increased producer prices, effective diseases and pests control programme, bonus payment, hi-tech programme (subsidized fertilizer for application) and replanting of denuded areas to enable the sub-sector contribute significantly to the growth of the agricultural GDP, foreign exchange earnings, employment generation and poverty reduction in the country.

It was in furtherance of the above that this study was conducted in 2011 to determine the impact of a national mass spraying programme instituted by the government in 2001 on how to meet the growing and future demands of cocoa and its products towards increased and sustainable cocoa yields. This comes as a result of the increased discretionary spending and high prices stimulating interest in the local cocoa market in Ghana- what could drive Ghana's cocoa-centric agribusiness market as the country moves into 2012 and even beyond-and how one could best exploit challenging local conditions as multinational firms choose to invest in the Ghanaian cocoa sector.

Using interview schedules, focus group discussions and personal observations, a total of sixty five (65) interviewees comprising forty (40) cocoa farmers and twenty five (25) sprayers were selected by purposive random sampling techniques in the Upper Denkyira West District in the central region of Ghana for the study.

Data was collected on the socio-economic characteristics of both cocoa farmers and sprayers employed under the programme, including output, cost of spraying, yield (before and after the programme), and constraints facing the effective, as well as farmers' perceptions on the benefits of the programme.

The results obtained from the study indicated that cocoa yield increased by 49.41% after the inception of the programme in spite of the challenges facing its implementation, while nominal cost of spraying an acre of cocoa farm increased by 271.69% with real cost increased by 0.2%. About 85% of the cocoa farmers indicated that the programme has generally been beneficial to them. Among the identified constraints militating against the successful implementation of the programme included insufficient spraying chemicals such as Confidor, Fungaran, Ridomil Gold Plus, Tara, "Akate Master" among others as well as inadequate motor fuels, delayed spraying time, pilfering of chemicals by some sprayers and supervisors, low remuneration for employees, and delay in logistics supply.

Key Words: Mass Spraying, Ghana, Cocoa Production.

Background of the Study

Cocoa originated from Mexico and parts of tropical America (Manu, 1989a). It was from these Islands, Fernando Po, Sao Tome and Principe that the cocoa plant was introduced to the African continent in the latter part of the nineteenth century (Mossu, 1992b). Cocoa was introduced into Ghana by Tetteh Quarshie in 1879 from Fernando Po (Adjinah and Opoku**,** 2010a).

The first documented shipment of two bags of cocoa, which was sent to Hamburg-Germany, was in January 1893(Asuming-Brempong et al, 2007). Since then, cocoa has been the main export

crop and a major source of foreign exchange for the government of Ghana and income earner for farmers.

In 2001, cocoa export contributed 16% ($246.7 million) to total exports (Agric Education and Training in Africa, 2011). The agriculture sector in 2002 employed about 70% of the rural labour force, contributed 45% to GDP and accounted for over 55% of the foreign exchange earnings (EPA, 2002). According to Dwinger (2010), cocoa contributed 9% to GDP in 2008.

For Sixty-six (66) years, (1911-1977) Ghana was the leading producer of cocoa with the market shares ranging from 30-40% (Adjinah and Opoku 2010b). Records indicate that cocoa production increased from a level of 36.3 Metric Tones (MT) in 1891 to about 557,000MT in 1964/65 giving Ghana a global output share of about 33% and the leading producer of cocoa at the time (Adjinah and Opoku, 2010c).

Thereafter, production continued to drop and reached the lowest of 158,956MT in 1983/84, which constituted 9% of the world's production. The decline in production was significantly influenced by the 1983 devastating drought, pests and diseases among others. Among these factors, the mirids/capsids (a pest) and Black Pod Disease were prominent and Ghana subsequently lost her position as the world's number one producer.

As part of efforts to arrest the decline in cocoa production, the government of Ghana through the Cocoa Board initiated a National Cocoa Disease and Pest Control (CODAPEC) programme, popularly called the Cocoa Mass Spraying Programme, to assist all cocoa farmers in the country to fight the capsid/mirid and the Black pod diseases. The aim of the programme was to increase cocoa production to 1,000,000 MT by 2012 (Adjinah and Opoku, 2010). The programme was introduced in the 2001/2002 cocoa season with a budget of about 32 million US Dollars

(Exchange rate of 1 $US to 1.87 Ghana Cedis (GNA, 2001). The programme covered all the six cocoa growing regions in Ghana, namely; Ashanti, Brong Ahafo, Central, Eastern, Western and Volta regions.

Some of the cocoa farmers, however, wanted to do the spraying themselves complaining the government workers seemed to be too slow (Akosa, 2001). Each farm was supposed to be sprayed three times between June and October in case of black pod and twice between August and September in the case of mirids. On the contrary, spraying for mirid control were observed to have been done only once in the district per a growing season. It would therefore interest stakeholders to be aware of the effect the programme has on cocoa production, since there are claims that the spraying was not being done in line with what was recommended at the onset.

A membership of ten (10) sprayers (gang) for black pod and six (6) for capsid programmes have a supervisor who is responsible for the general supervision at the unit level. Other objectives were to train farmers and technical personnel on the cultural methods of pest control, educate and train local sprayers on safe pesticide usage.

The farmers are responsible for the cultural practices (pruning, shade management, removal of black and other diseased pods), and provision of water for spraying and monitoring of spraying on the farm to ensure proper and satisfactory results.

Problem Statement

Cocoa (*Theobroma cacao*) belongs to the family Sterculiaceae, and out of the over twenty (20) species of cocoa, it is only the *Theobroma cacao* which is economically important and grown in Ghana as a major cash crop.

Until recently when Ghana discovered oil and gas in commercial quantities, Cocoa, otherwise called the chocolate tree is Ghana's largest source of foreign exchange as about 96% of the raw beans have been exported to countries such as Germany, the Netherlands, the United Kingdom and the United States of America.

Climatic requirements suitable for cocoa production in Ghana are usually found in the rain forests including the Upper Denkyira West District in the central region. It has been noticed that one of the challenges to cocoa high yields in Ghana over the years is the ineffective control of pests and diseases such as swollen shoot, black pod and capsid.

Following the immense benefits of the tree crop to the country, a programme dubbed: "Cocoa Mass Spraying" was instituted by the Government of Ghana (GoG) in 2001 to ensure maximum yields of cocoa with a target of reaching 1,000 000 MT by 2011. There however, seemed to have been numerous complains raised by cocoa farmers in the study area which have received little or no attention from Government and other stakeholders in the agricultural sector on the impact of the spraying programme on farmers' well being.

According to Akosa (2001a), the aim of the Cocoa Mass Spraying Programme is for bumper cocoa production. Nevertheless, it was found out that cocoa production in the central region declined from 62,000MT in 2007/2008 to 56,000MT in 2008/2009 cocoa major growing season (Ghana News Agency, 2010).

Furthermore, it was revealed by Akosa (2001b) that, cocoa pods sprayed under the programme could mean more money in the pockets of cocoa farmers due to its consequential reduction in spraying cost, hence an increase in their savings and purchasing power. However, the economic fortunes of the cocoa farmers in the study area seemed not to have improved substantially (Abankwa, 2010).

One then wonders how the programme has impacted on cocoa output in the study area since its inception in helping decrease farmers' cost of production. These concerns among others have necessitated this empirical study in the area.

Objectives of Study

The main objective of the study is to ascertain the impact of the Cocoa Mass Spraying Programme on cocoa yield/performance in the Upper Denkyira West District of the central region of Ghana.

The specific objectives are to:

1. Identify the socio-economic characteristics of cocoa farmers in the study area affecting yield performance.
2. Determine farmers' output before and after the Mass Spraying Programme.
3. Determine whether the programme has been able to help decrease the cost of spraying, leading to improved living conditions.
4. Identify the constraints facing the programme's effective implementation for higher yields of cocoa in the study area.
5. Determine the farmers' perception about the benefits of the programme towards sustainable cocoa farming in the area.

Justification of the Study

The implementation of the Mass Spraying Programme by government in committing huge amount of money into it with the aim of reviving the cocoa sub-sector would not just be enough but rather determining the impact the programme would have on cocoa production is worth

considering. It is therefore necessary to find out the impact of the Cocoa Mass Spraying Programme in the lives of the farmers in the study area.

Furthermore, this work will help unveil the production trend of cocoa before and after the implementation of the Mass Spraying Programme to the government and other institutions as an information source for policies regarding cocoa production in the country.

Assessing farmers' perception on the programme as to whether it is good or not would expose the constraints facing the programme and their suggestions as to how to deal with the constraints would be very vital to the Cocoa Disease and Pest Control (CODAPEC) Committee in revising their strategies in executing the programme to make it more effective and beneficial to farmers. This research will also leave behind some important literature for other research fellows who would like to conduct further research into cocoa in Ghana and elsewhere.

Literature Review

Brief History of Cocoa Production in Ghana.

Cocoa (*Theobroma cacao*), belongs to the *sterculiaceae* family. The genus *Theobroma* has twenty two (22) species. However, the only species grown commercially for the production of seeds for chocolate making or for the extraction of cocoa butter is *Theobroma cacao* (Mossu, 1992a). Cocoa originated from Mexico and parts of tropical America (Manu, 1989a).

Cocoa, an important commercial crop of the equatorial region, is extensively planted in areas bordering the Gulf of Guinea in West Africa, which include countries like Ghana, Nigeria, Cote d'ivoire, Liberia, Sierra Leone, Togo and Dahomey (Kishore, 2010). Most cocoa is produced by around 1.6 million small farmers on plots of less than three hectares (ha) in the forest areas of the Ashanti, Brong Ahafo, Centra, Eastern, western, and Volta regions of Ghana (ESDD, 2002).The first cocoa export to Europe from Veracruz to Cadiz dated back to 1585(Mossu, 1992c).

Ghana exported about 546.72 tones (T) of cocoa in 1900, 2,856.00T in 1905, over 26,520.00T in 1911 and in 1936, she exported 317,220T, representing half the total world production at the time (Manu, 1989b). In 1964/1965, Ghana became the leading producer of cocoa (Adjinah and Obeng, 2010c).

Akosa (2001) found out that Mass Spraying was last undertaken in the 1960s when the country was the world number one producer of cocoa. The introduction of the Mass Spraying exercise between 1959 and 1962 is believed to have resulted in the high production of over 580,000MT recorded in the 1964/1965 season. Production dropped to the lowest level of 158,956MT in 1983/1984, which made Ghana, lost her enviable position as the world's number one producer to

neighboring Cote d'ivoire. However, cocoa production rose to 734,699 T in 2003/04 cocoa season (GNA, 2005).

Cocoa and Ghana's Economy

The cocoa sector in Ghana employs over 800,000 smallholder farm families. The number of cocoa farm owners is estimated at 350,000. Cocoa farm sizes are relatively small ranging from 0.4-4.0 hectares (COCOBOD, unpublished data). According to Asuming-Brempong et al (2007), ninety eight percent (98%) of the workers in cocoa farms fall within 18-50 years. For the smallholder cocoa farmers, cocoa contributes about 70-100% of their annual household income (Asamoah and Baah, 2002). Cocoa employs about 50% of the agricultural labuor force in Ghana (Seini, 2002).

Ghana's recent robust economic growth, occurring at the same time as the country's cocoa Sector is booming, has attracted some interest in the economics literature (Zeitlin, 2005). The performance of the agricultural sector was aided by the strong recovery of the cocoa sub-sector, which improved from a low of 0.5% in 2002 to 16.4% growth in 2003 (The Daily Graphic, Wednesday, 7th January, 2004. Pp 1, 3). ISSER (as cited in Anifori, 2004) and the agricultural sector's growth rate of 4.2% in 1995 was boosted by the performance of the cocoa sub-sector which grew at 11.1%, even though the sub-sector contributed only 14% to the agricultural GDP.

In 2001, cocoa export contributed 16% ($246.7 million) to total exports (Agric Education and Training in Africa, 2011). In 2002, cocoa made up for 22.4% (463 million US $) of the total foreign exchange earnings. Cocoa constituted 63% of foreign exchange earnings from the agricultural sector (ISSER, 2003). According to Dwinger (2010), cocoa contributed 9% to GDP in 2008. In 2010, the Ministry of Food Agriculture (MoFA) revealed that, the agricultural sector

contributed about 37.3% to Ghana's GDP. They further stated that the cocoa sub-sector contributed 15% to National GDP. Given that, the cocoa industry is doing so well, it is quite reasonable to surmise that the growth of the cocoa industry is the engine behind the country's current impressive economic growth (Armah, 2008)

Trend of Cocoa Output in Ghana

West African Nations account for about 70% of the cocoa grown for the world market (Hainmueller et al, 2011). Nine (9) years before the mass spraying programme (i.e. 1963/64-1971/72) and nine (9) years of active mass spraying programme (i.e.2001/02-2009/10) was used to study the trend of cocoa output in Ghana (Fig 1). In 1964/65, Ghana produced a total output of 580,869 tonnes(T) and the leading producer of cocoa. Output continued to fall below the 1964/65 output until 2002/03. Three (3) years after the introduction of the mass spraying programme (2003/04), output increased past 1964/65 output to 736,976 T. According to Asuming-Brempong et al (2007), the mass spraying has had a positive impact on national cocoa production resulting in production in excess of 700,000T during the 2003/04 and 2005/06 cocoa seasons.

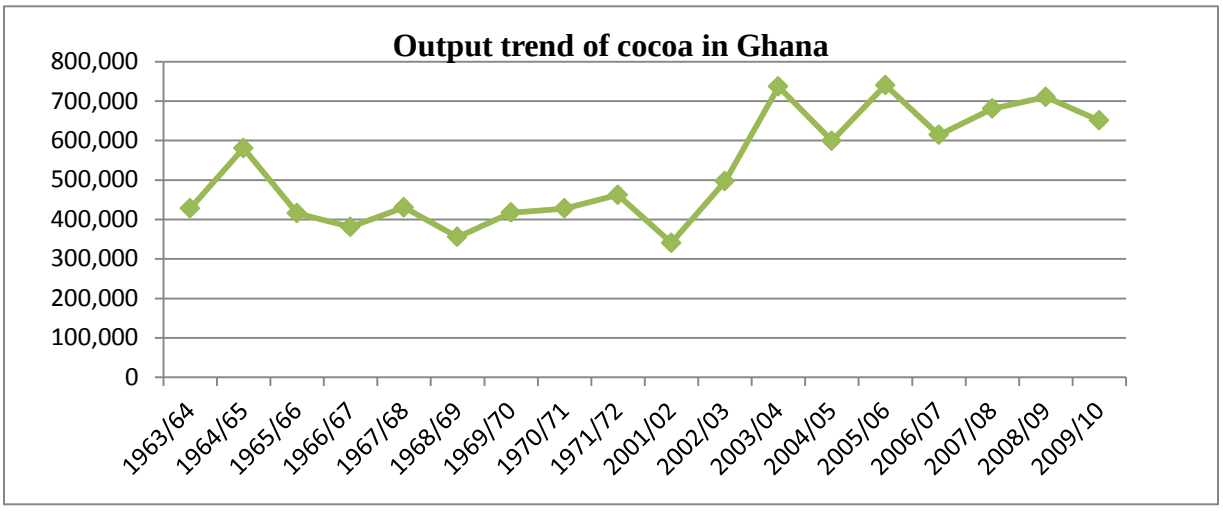

Figure 1: Modified output trend of cocoa in Ghana from COCOBOD.

Cocoa Yield in Ghana

Generally, yields of cocoa are lower in Ghana than in other major producing countries. Whilst the average cocoa yield in Malaysia stood at 1800Kgha^{-1} and 800Kgha^{-1} in Ivory Coast, it was only 360Kgha^{-1} in Ghana (Anon, 1999). However, production figures showed that yield has increased substantially in virtually all the districts across Ghana in recent times. (Adjinah and Opoku, 2010).

Research has shown that cocoa farmers can increase cocoa yield to 1000Kgha^{-1} or more (Aneani et al, 2011). The problem of low yields relative to potential has been ascribed to some constraints such as disease and pest, inefficiency in the allocation of resources and improper cultural practices (Aneani et al, 2011).

It has been mentioned in other researches that planting cocoa at stake with unspecified source of seeds at irregular spacing, high density, infrequent weeding, little or no pruning, infrequent removal of mistletoe, infrequent pest and disease control among others cultural practices could give a yield as low as 5.5bags/ha or 2bags/acre.

It has further been observed that, planting improved cocoa seeds from designated gardens used for planting, regular spacing, regular weed management, shade management, frequent disease and pest control, and fertilizer application once a year among other improved cultural practices could give a yield as much as 22bags/ha or 9bags/acre or more.

Cocoa Certification and Child Labour Issues

The Ghana COCOBOD intensified its sensitization programme on the elimination of the worst forms of child labour in cocoa production and has also provided monetary support to the

National Programme for the Elimination of Child Labour in Cocoa (NPECLC) in the cocoa sector to enforce the child labour provisions in various legislations. This was in direct response to international concerns about child labour abuses on cocoa farms in West African countries as reflected in the Harkin-Engel Protocol. The cocoa labour survey and the preparation of the Cocoa Certification Report which is a requirement under the Harkin-Engel Protocol was completed, and the International Cocoa Verification Board (ICVB) accepted the 2008 Ghana Certification Report (GCR).

Uses of Cocoa

Cocoa is used in manufacturing many finished and unfinished products. Some of the finished products are chocolate powder, bars of chocolate and chocolate confectionery (Mossu, 1992). Mossu included cocoa beans (used for making chocolate, biscuits and confectionery) and cocoa butter (used in making sweets, perfume and in pharmacy), and also reported that, the by-products of cocoa (husk, fats extracted from husk) are used to feed cattle, manufacture fertilizers, pharmaceutical products and soap.

Nutritional and Medicinal Values of Cocoa

Cocoa is a plant-based food that contains carbohydrates, fats, proteins, natural minerals and some vitamins. Like several other plant foods such as tea, red wine, fruits, vegetables and nuts, cocoa contains a group of compounds which exhibit health benefits, although these may be affected by fermentation and processing of the cocoa beans (Kenny, T. et al, 2004). The cocoa beans are used mainly in the manufacturing of chocolate and chocolate drinks. Cocoa contains vitamin E and some vitamin B complex such as thiamine, riboflavin and niacin (Keen C, et al, 2003). There is a growing body of evidence about the health benefits of cocoa flavanols (Zhu, Q. et al. 2002).

The cocoa component in chocolate is rich in a number of essential minerals, including magnesium, copper, potassium and manganese, sodium, calcium, iron, phosphorus and zinc, which perform important roles in the physiology of the human body (Mursu J. et al. 2004). Dietary copper is believed to contribute to the prevention of heart disease and chocolate is thought to be one of the largest single contributors of copper to the diet. Laboratory and human studies indicate that cocoa flavonols can help prevent cholesterol effect thereby helping to prevent the buildup of fibrous plaques on the arterial walls.

Pests and Diseases of Cocoa

A range of pests and diseases affect Cocoa, with some estimates putting losses as high as 30% to 40% of global production (International Cocoa Organization (I.C.O), 2010a). The Black pod disease is the most destructive of a number of diseases, which attack the developing and/or ripening cocoa pods worldwide. The Black Pod disease is caused by the fungus *Phytophthora spp*. Three fungal species of the same genus are responsible - *P. palmivora*, *P. megakarya and P .capsici*. The P. *palmivora* causes global yield loss of 20-30% and tree deaths of 10% annually (I. C. O, 2010b). In Ghana, the disease is caused by two *Phytophthora* species: *P.palvimora and P. megakarya* (Opoku et al, 1999). Generally, losses due to P. *megakarya* range from 60-80% in newly attacked farms to about 100% in old affected farms in the black pod season:May-mid June (Blencowe and Wharton, 1961). Losses for P. palvimora are estimated at 4.9-19% (Darkwa, 1984).

Mirids are the major insects that affect cocoa worldwide. Mirids are sucking insects and they damage the soft tissues of the tree by piercing the young shoots with their mouthparts injecting poisonous saliva and then sucking liquid food out of the wound made and as a result, the affected

shoot dies. In young cocoa, the whole plant may be killed. On mature cocoa capsid damage occurs year after year in small, scattered areas called ‘capsid pockets’, again causing die back. In 2010, International Cocoa Organization (I. C. O) revealed that, cocoa mirids have been identified as a serious pest in Ghana since 1908 due to their devastating effect, International Cocoa Organisation (I. C. O) further stated that, mirid damage alone, if left unattended for three years, can reduce yields by as much as 75%.The most common species of this pest in Ghana and West African countries are *Distantiella theobroma and Sahlbergella singularis.* The insect are usually most and destructive from September-March particularly when moisture deficit is severe. Their activities are favored by high light intensity and humidity in the cocoa micro-environment (WACRI, 1951). Other pests and diseases of minor effect are, cocoa mosquito, pod boring caterpillar (*Marmara sp.),* mealybug (*Stictococcus sp*.).

The current recommended chemicals for controlling the Black Pod Disease, in Ghana include Fungaran, Ridomil Gold Plus and Cocide. Spraying against Black Pod disease with knapsack spraying machine is done at three or four weekly intervals in the district.

Shade and canopy management are the cultural practices that farmers undertake as cultural measures in controlling the Black Pod disease. However, cultural practices are not effective against P. *megakarya* (I.C.O, 2010).

Major Cocoa Cultural Practices

Land Selection and Preparation

In Ghana, cocoa is grown mainly in the forest areas of Ashanti, Brong-Ahafo, Central, Eastern, Western and Volta Regions where rainfall is between 1100mm and 3000mm per annum.

Extremely wet and swampy lands are not suitable as well as rocky places (Cocoa Research Institute of Ghana, 1987).

According to Mossu (1992), forestland with deep sandy-clay soil, which is as rich as possible in minerals, is the most suitable for cocoa production in Ghana.

Cocoa farmers clear their land and fell some of the big trees, which are economically unimportant during the dry season (Manu, 1987). The clearance of undergrowth and the felling of forest trees should be carried out in the dry season. He furthermore stated that the land must be prepared at least one year before the cocoa seedlings are planted out. The preparation must involve the land being cleared and shadings arranged to provide shelter for the young plants that will be transplanted. To provide the most suitable conditions for the young plants, it is advisable to replace the shade by establishing shade trees after felling the forest completely. As indicated by Ghana Cocoa Research Institute (1987), where there are not enough trees, plant quick growing trees like *Glyricidia* sp. or food crops such as cassava, plantain and cocoyam to provide shade for the young plants. The temporary shade provided by the food crops provides direct shade to the cocoa seedlings. The farmer in turn depends on the food crops as a staple for the household and for economic sustenance during the growing period of the cocoa (Benneh, 1987).

Fertilizer Application

It is stated that yield of cocoa can be increased by 30% by applying fertilizer. However, it is uneconomical to apply fertilizer to young cocoa plants. It is recommended that fertilizer be applied to plantations 10 years and above at two year intervals. For the use of fertilizer to be effective, it must be done with good management practices such as timely weed control, removal of shades and removal of mistletoes (Cocoa Research Institute (CRI), 1987).

Pests and Diseases Control

In 2010, International Cocoa Organization (I.C.O) revealed that the use of organochlorine insecticide has proved to be effective in Ghana in controlling the mirids pest. The current recommended insecticides that are being used by the farmers in Ghana include Confidor, Cocostar, Akate Master, Cabamult, and Atara. Insecticides are applied as foliar spray using motorized mist-blowing machines.

Mistletoe is another serious and major parasitic pest that attacks mature/grown up cocoa trees, and if not removed early, they destroy the young branches of the cocoa trees, rendering the tree unable to bear healthy and good fruits. Mistletoe is controlled by removal of the affected parts of the tree with the mistletoe altogether to prevent it from spreading to other parts of the tree. This is usually done by the use of a cutlass.

Gutter/Canal Cutting

This is another important cultural practice done to control water-logging on the cocoa farms. These canals are made in specified dimensions to ensure easy flow of excess water out of the farms when it rains heavily to avoid the negative effects of stagnant water on the farms, which can lead to the lodging of young cocoa plants.

Methodology

Study Area.

Upper Denkyira West District is located in the Central Region of Ghana with Diaso as its district capital, which was carved out of the defunct Upper Denkyira District. It lies within latitude 5º 30'' and 6º 02'' North of the equator and longitude1º W and 2º W of the Greenwich Meridian. The population of the district is about 52,000 (Ghana Population and Housing census, 2000). The topography of the land area is undulating and falls under a forest-dissected plateau, rising to about 250m above sea level. The vegetation is semi-deciduous rain forest. The soils of the district are generally of the forest echosols. This series consist of brown to yellowish brown, slightly acidic and moderately well-drained clay developed on alluvium. There are also other soil types of Akroso series favorable for the plant growth. These are also rich in alluvial gold. The mean temperature ranges from 24ºC in the coolest month of July to about 29ºC in the hottest months of March-April, with a bi-modal rainfall pattern.

The good nature of the vegetation and soils tend to promote the cultivation of cash crops such as cocoa, oil palm, food crops (plantain, cassava, maize, and cocoyam), citrus. Other major economic activities in the district include mining on both small and large scale, and timber logging.

Sources of Data

The data for the study was obtained from both primary and secondary sources. The primary data was obtained through the administration of structured and semi-structured questionnaires (Appendix 2), key informant interviews and personal observations. These were used to obtain

relevant information from cocoa farmers and spraying gangs engaged in the mass spraying programme by government under the Ministry of Food and Agriculture (MoFA).

Secondary data was sourced from the Ghana Cocoa Board (COCOBOD), offices of the District Assembly, and the Ministry of Food and Agriculture (MoFA).

Sampling Procedure and Size

Five (5) communities namely Dankwakrom, Jameso Nkwanta, Diaso, Modaso and Denkyira Obuasi were randomly sampled for the study, and the same technique used to select eight (8) cocoa farmers from each community for the study. The snowball sampling technique was used to select five (5) sprayers from each community for the interview. In all, a total of forty (40) cocoa farmers and twenty five (25) sprayers constituting sixty five (65) was used as the sample size.

Method of Data Analysis

The simple weighted ranking method was used to rank the constraints of the programme in order of preference, to determine the most pressing constraint. The Kendal's coefficient of concordance was used to measure the agreement among respondents.

That is, Kendal's coefficient of concordance (W) = $12\ (\sum T^2 - (\sum T)^2/n) \div (nm2\ (n^2-1))$

Where, W= Kendal's coefficient of concordance

T = Sum of ranks for constraints being ranked, n= number of problems, m= number of respondents

W ranges from 0.00 to 1.00 Where 0= perfect disagreement and 1= perfect agreement

The following hypotheses were formulated:

H_o= There is no agreement among the rankings of the constraints

H_a= There is agreement among the rankings of the constraints

W was further tested using the F- ratio

Therefore, F- calculated = (m-1)*W/ (1-W)

Then F-critical was determined by considering:

1. Degree of freedom numerator = (n-1)-2/n

2. Degree of freedom denominator = (m-1) [(n-1)2/m]

If F- calculated is greater than F- critical, we reject the null hypothesis.

The 'before' and 'after' comparison was used to determine whether cocoa farmers' have been able to reduce the cost of spraying as well as whether they have been able to increase their yield, and in making them comparable, all monetary values were deflated to get their real incomes. GDP deflator using the cost of spraying before the programme as the base period was used.

Mathematically;

Real Average Cost of spraying = Nominal Cost of spraying ÷ GDP Deflator

But GDP Deflator = (C_t/C_b) Where C_t=current cost, C_b= cost of base year

Percentage increase in yield = $((T_{t-1}-T_t)/T_t)) *100$

Where T_{t-1} =Total yield after mass spraying, T_t = Total yield before mass spraying

Computer programmes STATA,SPSS and MS Excel were employed in analysis of the data, and the results presented in the form of simple descriptive statistics such as frequency tables, percentages, bar and pie charts.

Results and Discussions

Demographic Characteristics of Respondents

Gender Distribution of Respondents.

The study showed that 70% of the cocoa farmers are males as against 30% females as in Fig. 1 below.

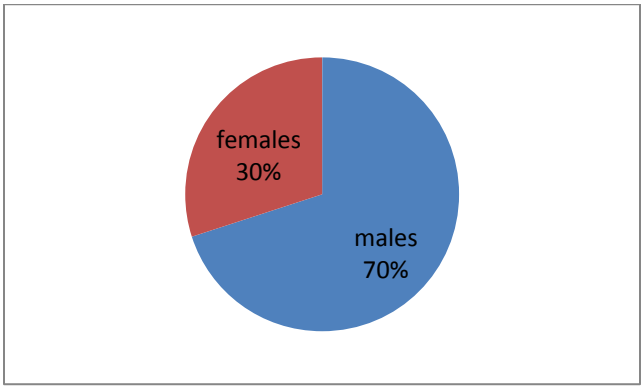

Figure 1: Gender of Cocoa Farmers

The high number of males was attributed to the fact that most men are household heads in the study area and who have control over the household members and its productive assets including land and tree crops such as cocoa.

For that of the sprayers, out of the 25 sprayers interviewed, none was found to be a female (100% males). The 100% male sprayers tended to stress what respondents said earlier that spraying is very tiresome and described it as ‘men’s work’ only.

Age Distribution of Respondents

The age group for the cocoa farmers indicated that 21-30 was 5%, 31-40 was 27.5% whilst 41-50 was 35%. The age group of 51-60 was 30% and above 60 years was 2.5% (Fig. 2 below)

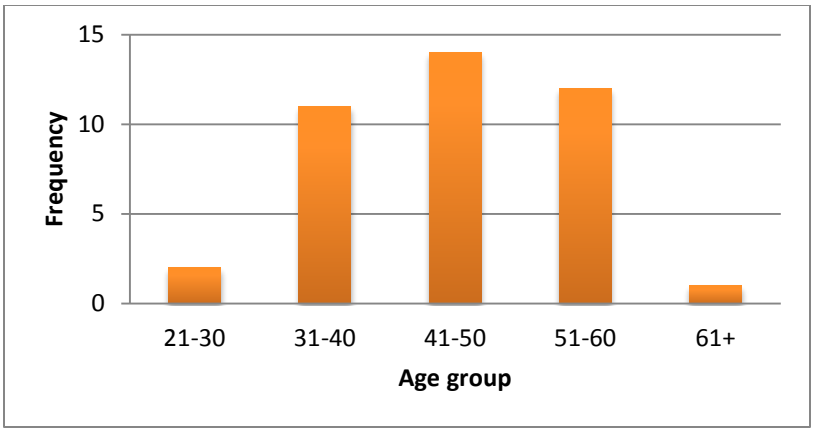

Figure 2: Age distribution of cocoa famers.

The mean age of the interviewees was 45.7, which implies that there are more active working force age group in the cocoa farming area than non-active age group, and which is indicative of good and strong working force for sustainable cocoa production in the study area and for years to come.

The age group 21-30 (40%), 31-40 (36%) and 41-50 (24%) were that of the sprayers (Fig. 3 below). The mean age of the sprayers was 34.2 years, implying that the active youth are those who are mostly into this service. It goes to confirm what the respondents said that spraying is a tedious activity and undertaken mostly by men.

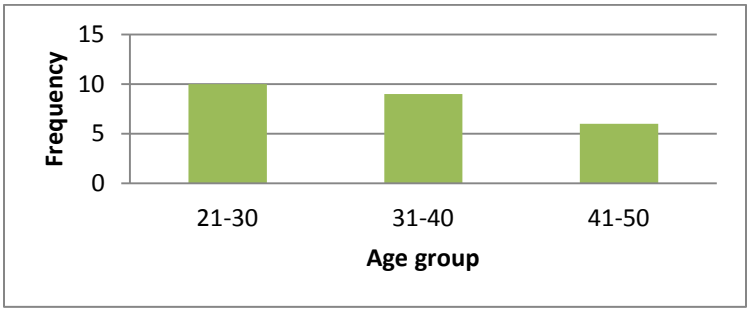

Fig. 3: Age distribution of sprayers.

Educational Status of Respondents

The research brought to the fore that 2.5% of the cocoa farmers had primary education, 50% had Junior High education and 12.5% had Senior High education while 12.5% also had Tertiary education and 22.5 % (Table 1 below) did not have formal education at all. With a greater number of farmers (77.5%), having at least basic education is an indication that new technologies of cocoa production including the mass spraying of the cocoa in the area could easily be adopted since earlier researches confirmed that higher levels of education of farmers has a positive correlation to early adoption of improved agricultural technologies in Ghana.

Table 1: Educational Status of Cocoa Farmers

Educational status	Frequency	Percentage (%)
Primary	1	2.5
JHS	20	50
SHS/TECH.	5	12.5
Tertiary	5	12.5
No Formal Education	9	22.5

Source: Field survey, 2011.

For the 25 sprayers interviewed, none of them had tertiary education. However, two (8%) had Senior High School/Technical education while sixteen (64%) had Junior High School (JHS)/ Middle School education. Respondents who had Primary education were 8% while those who had no formal education were 20%, as in Fig. 4.

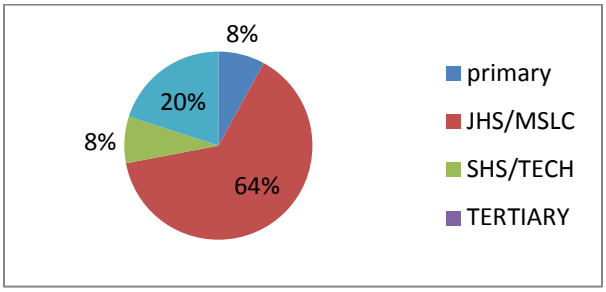

Fig.4: Educational status of Cocoa Sprayers

Marital Status of Cocoa Farmers

It was revealed by the study that, the household-dependency ratio was 1:6. Also, three (3) farmers out of the forty interviewed, representing 7.5% were not married, thirty-three of them (82.5%) were married and one (2.5%) was divorced, whereas three (7.5%) were widowers (Figure 5). Cocoa farming is noted to be labor intensive and it affirms the fact that cocoa famers mostly rely on family members for cheap labor on their cocoa farms, hence the higher percentage of married couples engaged in it.

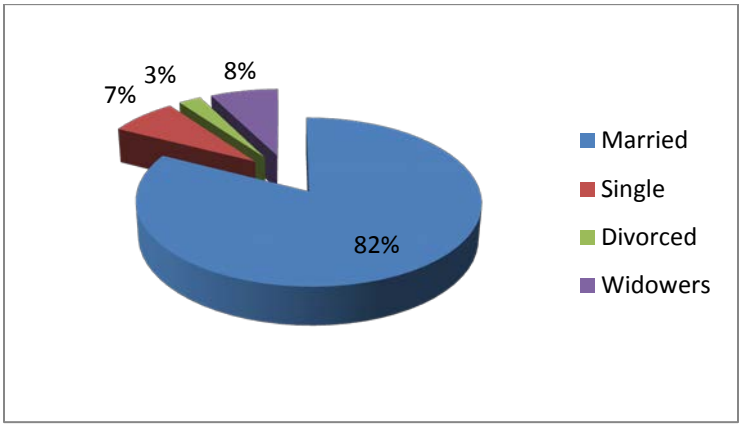

Fig. 5: Marital status of Cocoa Farmers

Occupation and Sources of Income for Cocoa Farmers

The study found out that 85% of the respondents have taken to cocoa farming as their major occupation with the remaining 15% who engaged in cocoa farming as minor occupation. Cocoa production was found to contribute about 72% of the farmers' annual household income while other food crops and livestock contributed 2.88% and 0.38% respectively. Off-farm income also contributed 24.74% to the cocoa farmers' annual household income in the study area. This confirms Asamoah and Baah, (2003), that for smallholder cocoa farmers, cocoa contributes about 70-100% of their annual household income.

Output of Cocoa before and after the inception of the Mass Spraying Programme

The study showed that cocoa output increased tremendously from a mean of 13.68 to 23.80 bags per farmer per season per acre, representing 73.98% increase in mean output. This was ascribed mostly to the fact that the mass spraying had had a positive impact on national cocoa production (Asuming-Brempong et al, 2007). This also confirmed Abankwa et al, 2010, that the national mass spraying programme has been able to rejuvenate cocoa production in Ghana by raising output levels higher.

It was also noted that the mean farm size of a farmer was 8.6 acres (3.43ha) before the programme was instituted but it increased to 9.7 acres (3.87ha), representing 12.83% increase in farm size after the programme was instituted. This further confirmed data from COCOBOD that cocoa farm sizes are relatively smaller ranging from 0.4 to 4.0 hectares, and further showed that output increased at a less than proportionate increase in farm size, as depicted in fig. 6 below.

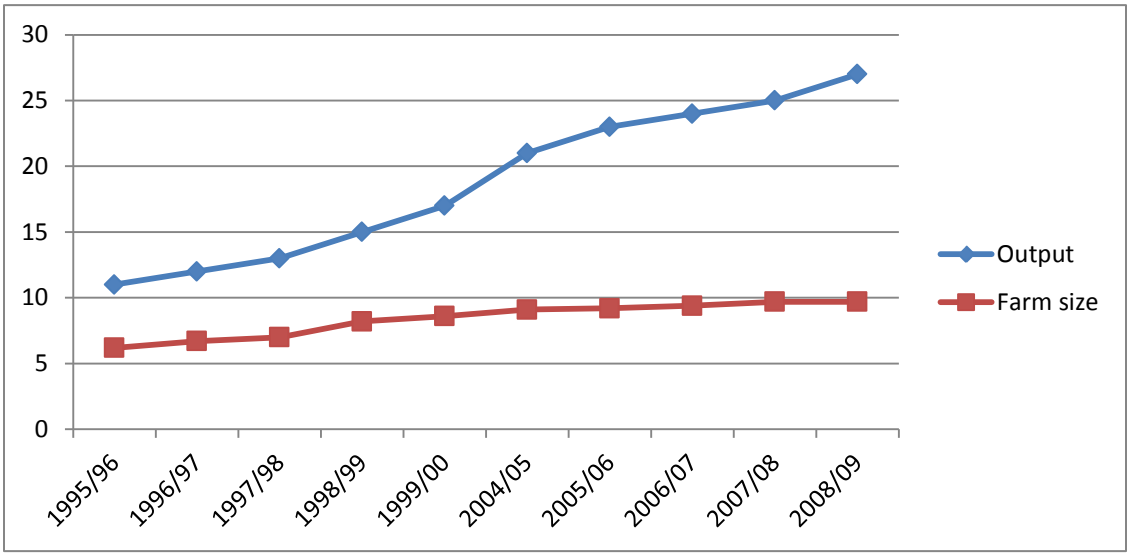

Figure 6: Trend of output and farm size of cocoa

Cost of Spraying before and after the inception of the Mass Spraying Programme

The study revealed that the cost of spraying an acre of cocoa farm before the inception of the mass spraying programme was *GH₵ 5.51, but it increased to GH₵ 20.48 after the inception of the programme, representing a 271.69% rise in nominal cost of spraying.

Where rise in nominal cost = ((20.48-5.51) ÷ 5.51) x 100= 271.69%

Using the above cost of spraying an acre before the mass spraying as the base period, the GDP Deflator = 5.51÷ 5.51 = 1.0 =100%

The GDP Deflator after the inception of the mass spraying programme = 20.48 ÷ 5.51 = 3.71

Now, real cost of spraying an acre = Nominal Cost of spraying an acre ÷ GDP Deflator

Therefore, real cost of spraying an acre before the programme = 5.51÷1 = GH₵ 5.51, while the real cost of spraying an acre after the programme = 20.48 ÷ 3.71 = GH₵ 5.52

Hence, real increase in cost of spraying an acre = 5.52-5.51 = GH₵ 0.01 which represents a 0.2% increase in real spraying cost at the same time as the number of times of spraying increased by 33.33%, indicating an inelastic relationship between the number of times of spraying and spraying cost. Farmers' ability to spray for at least three times after the initiation of the mass spraying programme as compared to one time spraying before the programme, confirms the claim by farmers that producer prices were higher after the mass spraying programme than before the mass spraying programme, which further affirmed that the mean producer prices in the years under comparison increased by 565%**.**

* Exchange Rate: 1 US Dollar = 1.55 GH₵

Cocoa Yield before and after the Mass Spraying

The total yield of cocoa before and after the inception of the mass spraying is presented in table 2, Appendix 1.

Percentage increase in yield = $((T_{t-1}-T_t)/T_t)) \times 100$

Where T_{t-1} =Total yield after mass spraying, T_t = Total yield before mass spraying

Percentage increase in yield = $((13.88-9.26)/9.26)) \times 100$

= 49.41%

The above demonstrates that total cocoa yield increased by 49.41% after the inception of the cocoa mass spraying programme in the study area. This was attributed to the fact that the factors of production were being put into efficient use after the initiation of the programme than they were before. The highest yield in the study area after the mass spraying was obtained in the 2008/09 cocoa growing season.

Major Constraints facing the Programme

Ranked constraints facing cocoa farmers

Table 3a in Appendix 1 shows the various constraints facing sprayers and their rankings.

In using the Kendal's coefficient of concordance (W) = $12 (\sum T^2 – (\sum T)^2/n) \div (nm2 (n^2-1))$

Where, W= Kendal's coefficient of concordance, T = Sum of ranks for constraints being ranked

n= number of problems, m= number of respondents

$\sum T^2$= 208818, $(\sum T)^2$= 1267876

n= 7, (n^2-1)= 48, m= 40, nm^2= 11200

Therefore, W= 12 (208818-(1267876/7)) ÷ (11200*48), W= 0.62

Therefore, W is more perfect in agreement than disagreement.

From the hypothesis stated;

H_o= There is no agreement among the rankings of the problems

H_a= There is agreement among the rankings of the problems

W is then tested using the F- ratio

Therefore, F- calculated = (m-1)*W/ (1-W)

But m= 40, W= 0.62, F-cal = (40-1)*0.62/ (1-0.62) = 62.63

Then F-critical, degree of freedom numerator = (n-1)-2/n = (7-1)-2/7 = 5.71

Degree of freedom denominator = (m-1) [(n-1)2/m] = (40-1) [(7-1)2/40] = 11.7

From F- table, comparing the degree of freedom numerator and denominator, the F-critical=3.00.

Since F- calculated (62.63) is greater than F- critical (5.71), we reject the null hypothesis. Hence, there is agreement among the rankings.

This is an indication that there is a strong agreement between respondents that the most pressing constraint was insufficient supply of pesticides while pilfering of the chemicals by sprayers was the least pressing constraint. This buttressed Abankwa et al (2010) that the setbacks identified in the Cocoa Mass Spraying Programme included insufficient supply of pesticides, stealing of pesticides by sprayers and inadequate supply of fuel for timely and effective spraying.

Ranked Constraints facing Sprayers.

The table 3b in Appendix 1 shows the ranked constraints facing sprayers.

Again, from Kendal's coefficient of concordance (W) = 12 $(\sum T^2 - (\sum T)^2/n) \div (nm2\ (n^2-1))$

Where, W= Kendal's coefficient of concordance

T = Sum of ranks for constraints being ranked, n=number of problems, m=number of respondents

$\sum T^2$= 17333, $(\sum T)^2$= 62001, n= 4, (n^2-1) = 15, m= 25, nm^2= 2500

Therefore, W= 12 (17333-(62001/4)) ÷ (2500*15), W= 0.59

W ranges from 0-1. Where 0= perfect disagreement and 1= perfect agreement

Therefore, W is more of perfective agreement as to perfective in disagreement.

We then formulate our hypotheses:

H_o= There is no agreement among the rankings of the problems

H_a= There is agreement among the rankings of the problems

W is then tested using the F- ratio

Therefore, F- calculated = (m-1)*W/ (1-W)

But m= 25, W= 0.59, F-cal = (25-1)*0.59/ (1-0.59) = 34.537

Then F-critical, degree of freedom numerator = (n-1)-2/n = (4-1)-2/4 = 2.5

Degree of freedom denominator = (m-1) [(n-1)2/m] = (25-1) [(4-1)2/25] = 5.76

From the F- table, comparing the degree of freedom numerator and denominator, the F- critical= 4.76

Since F- calculated (34.537) is greater than F- critical (2.5), we reject the null hypothesis. Hence, there is agreement among the rankings.

Perception of Cocoa Farmers on the Benefits of the Programme

Out of the 40 cocoa farmers interviewed, 85% of them accepted that the programme has been good while 15% had reservations about it (Fig. 7 in Appendix 1). Among the reasons for the programme being good according to the farmers were the supplies of free pesticides, cheap labor for spraying, leading to the overall reduction in the cost of production and an increase in output. Some reasons given for the programme not being good was mainly centered on discrimination by

the sprayers against some farmers in the area, whose farms were either sprayed late or not at all. The higher percentage of people who were in favor of the programme was because the relationship between the number of times of spraying and the cost of spraying has been inelastic over the years. From the study, the number of times of spraying increased by 33.3% whilst the real cost of spraying increased only by 0.2%, which made farmers better off by increasing output at a less than proportionate increase in cost of production.

Conclusion

The findings indicated that men, who are mostly household heads, have dominated cocoa production in the study area. However, with the 30% of women involved in the male dominated tree crop production points to a good sign that daring women can and should venture into owning cocoa farms to improve their fortunes.

Cocoa contributes about 72 % to annual household incomes of cocoa farmers in the district.

It was identified that the programme has not been able to reduce cost of spraying drastically because of the fact that some of the farmers were spraying their farms at a lesser number of times earlier than they currently do; so the higher the number of times farms sprayed, the higher the cost, *ceteris paribus*.

The major constraint facing cocoa production under the programme is inadequate chemicals supply, indicating that there has not been the required commitment to the provision of materials and other logistics for successful execution of the programme by the governing authorities. The study also indicated that most cocoa farmers are generally younger and active contrary to growing worry in other areas where mostly cocoa farming rests in the hands of the elderly in the communities with the younger ones migrating to urban centers in search of non-existent greener pastures.

Most cocoa farmers have embraced the programme following its tremendous contribution towards improving their living standards comparatively.

Recommendations

Based on the findings of the study, the following are some recommendations:

Since the Mass Spraying programme is a governmental policy, there should be adequate and continued government commitment by way of provision of adequate materials and other logistics for its smooth operation in the study area.

There should also be some training for the chemical sprayers to ensure economy and efficiency of the spraying exercise.

Persons found pilfering with the supplies should be prosecuted by law to serve as deterrent to others.

Efforts should be made to provide more spraying gangs to ensure timeliness and efficiency of the spraying.

The youth in the district should be encouraged to stay in the rural areas and help their aging parents manage the cocoa farms very well, thereby preparing themselves to take over from their parents later in life as a family farming business.

Further study should be carried out to determine the effects of the chemicals used for spraying the cocoa on consumers' health.

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Appendices

Appendix 1

Table 2: Cocoa yield before and after the mass spraying programme

Year	Total plot size (acres)	Total output (bags)	Total yield (bags/acre)
1995/96	248	424	1.71
1996/97	266	486	1.83
1997/98	279	525	1.88
1998/99	327	613	1.87
1999/00	343	688	2.00
2004/05	362	834	2.30
2005/06	368	985	2.67
2006/07	376	1069	2.84
2007/08	387	1100	2.84
2008/09	387	1250	3.23

Source: Field Survey, 2011

Table 3a: Ranking of constraints facing farmers

Constraint	Overall rank	TWS	Rank score of constraints						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Insufficient supply of pesticides	**1st**	**38**	**30**	**4**	**2**	**2**	**0**	**0**	**2**
Inadequate supply of fuel for spraying	**2nd**	**51**	**5**	**31**	**1**	**1**	**2**	**0**	**0**
Delayed spraying	**3rd**	**80**	**0**	**1**	**28**	**8**	**3**	**0**	**0**
Poor delivery by sprayers	**4th**	**94**	**2**	**0**	**6**	**27**	**2**	**3**	**0**
Breakdown of spraying machines	**5th**	**114**	**3**	**2**	**2**	**0**	**27**	**4**	**2**
Discrimination	**6th**	**138**	**0**	**2**	**0**	**2**	**6**	**26**	**4**
Pilfering of chemicals by sprayers	**7th**	**160**	**0**	**0**	**1**	**0**	**0**	**7**	**32**

Source: Field survey, 2011

Table 3b: Ranked constraints facing sprayers

Constraint	Overall rank	TWS	Rank score of constraints			
			1	2	3	4
Low salary	1st	32	21	2	1	1
Delay in logistics supply	2nd	55	3	15	6	1
Side effects of the chemicals	3rd	72	0	7	14	4
Inadequate assistance by farmers	4th	90	1	1	5	18

Source: Field survey, 2011

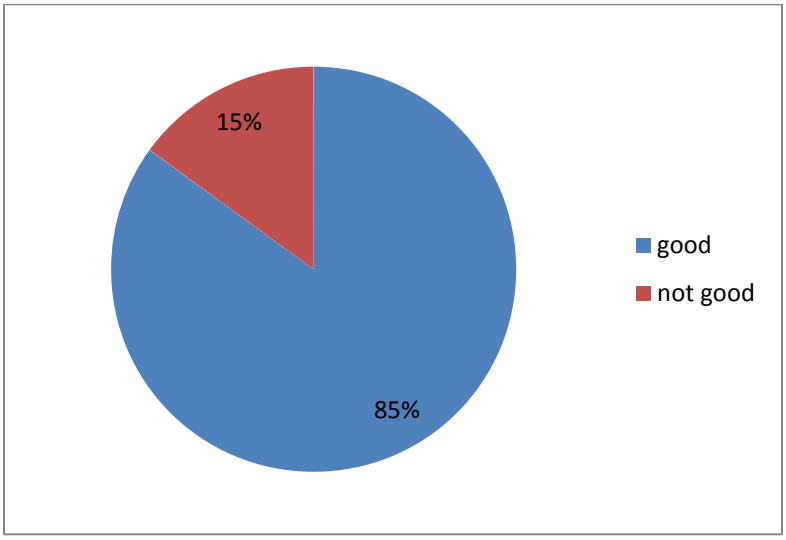

Figure 7: Farmers perception on the programme benefits

Appendix 2

University for Development Studies

Department of Agricultural Economics and Extension

Nyankpala-Tamale

Questionnaire

A. General Information

Name of community…….....District……

Name of Respondent…….....

1. Gender of Respondent: ☐ Male ☐ Female

2. Age: ☐ 18-30 years ☐ 31-43 years ☐ 44 and above

3. Marital status: ☐ Single ☐ Married ☐ Divorced ☐ Widow/widower

4. Size of family:

Category	**Number**
Adult male	
Adult female	
Boys	
Girls	

5. Form of Religion: ☐ Christianity ☐ Islam ☐ Traditional ☐ Others (specify) --------

6. Level of Education: ☐ Primary ☐ J.H.S/MSLC ☐ S.H.S./Technical ☐ Tertiary

☐ Non-Formal

B. Cocoa Production

7. Occupation (a) Major…….. …….(b) Minor (i)……

(ii)……

8. What type of crops do you cultivate in addition to cocoa farming? i.....

ii.....

iii…….

9. How many years have you been in cocoa farming?.....

10. a. Would you say cocoa farming has been beneficial to you and your family over those years? ☐ Yes ☐ No

b. If yes, what could be the reason(s)?

……...

….....

c. If no what could be the reasons(s)

……

……

11. a. Is cocoa production your main source of income? ☐ Yes ☐ No

. b. If no, mention the other sources……

c. How much do you get from those sources in a year?.....

12. What quantity of cocoa did you harvest at the end of the last growing season (in bags)……

13. Has there been an improvement in your cocoa yield(s) over the years? ☐ Yes ☐ No

14. Do you think you can increase the yield of production, given the chance? ☐ Yes ☐ No

15. What would you do or like to be done to improve the yield?

…….

16. a. What is the price per bag of cocoa at the end of the last growing season (GH¢)?

……....

b. Is this price an increase or decrease over the previous year (s)?.....

c. If increase/decrease, what might have been the cause?

……..

17. Have you heard about the Government's Mass Spraying Programme on cocoa?

☐ Yes ☐ No

18. Is the programme going on in your cocoa farming community? ☐ Yes ☐ No

19. a. Are you a beneficiary of that mass spraying programme in your cocoa farm?

☐ Yes ☐ No

b. If no, why?.....

20. When did you join or start to benefit from the Mass Spraying Programme? ……

21. a.Do you think the programme has helped increase your cocoa production/yield?

☐ Yes ☐ No

b. If yes, by how much? ……Before (in Bags/acre)……During (in Bags/acre)

22. What is the main reason for the Mass Spraying of the cocoa by Government?

……..

23. How many times did you spray your farm in a year before this programme was introduced?

…….

24. How many times do you now spray or have your farm sprayed because of this programme?

…….

25. Are the chemicals given out to you or sold to you? ……....

26. a. Do you do the spraying yourself? ☐ Yes ☐ No

b. If no, who does it?.....

27. a. Do you buy your own chemicals for spraying? ☐ Yes ☐ No

b. If yes, are the recommended chemicals readily available in the market? ☐ Yes ☐ No

28. What are the names of some of the recommended chemicals……..

……

29. Why would you prefer buying the chemicals while the government supplies them free?

…….

30. How many spraying gangs do you have in your community?.....

31. Were they able to successfully spray your farm(s) between 2004-2009? ☐ Yes ☐ No

32. How many times do they spray the farm in a growing season?.....

33. When do they spray your farm? i. First Spraying.....

ii. Second Spraying……..
iii. Third Spraying…….

34. Which year(s) were they unable to spray your farm?.....

35. Why were they unable to spray your farm? ……

……

36. a. Would your community need more spraying gangs? ☐ Yes ☐ No

b. If yes why?.....

c. If no why?.....

37.a.Do you know the right volume of chemicals to be used per spraying tank? ☐ Yes ☐ No

b. If yes, specify…….……

38.Have you been given orientation on how to use the spraying chemicals? ☐ Yes ☐ No

39.Would you like the programme to continue? ☐ Yes ☐ No

c. Give reasons
……

40.What is your opinion about the constraints facing the programme?.....

41. What recommendation(s) would you like to make to government to help mitigate these constraints?.....

42. a. Are the 2004-2009 duration yields higher than that of the 1995-2000? ☐ Yes ☐ No

42 b. complete the table below:

YEAR	1995-1996	1996-1997	1997-1998	1998-1999	*1999-2000*	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009
Plot Size(Acres)										
Output(Bags)										
Yield(Bags/Acre)										
Fertilizer Cost										
Labor Cost/Acre										
Cost of Seeds										
Cost of Spraying										
Cost of other Inputs										
Cost of Land										
Cost of Production										

C. **Sprayers**

1. How many days do you go to work in a week? …….
2. a. Were you trained before being employed as a gang sprayer? ☐Yes ☐ No
   b. If yes for how many days……..
3. a. Have you received further training since you were employed?☐ Yes☐ No
   b. If yes for how many days…….
4. How many litres of chemicals are you supposed to spray every day?.....
5. How many litres of chemicals do you spray a day?.....

6. How many times are you supposed to do the spraying on every farm?.....
7. How many acres are you able to spray in a day?.....
8. Are there delays in the supply of logistics? ☐ Yes ☐ No
9. How much are you paid for the service?.....
10. Are you paid casually or monthly?.....
11. When are you to do the spraying?.....
12. Do farmers give you the necessary assistance when rendering your services? ☐ Yes ☐ No
13. What are the major constraints facing the effectiveness of this programme?
14. What recommendation(s) would you make to the government to mitigate these constraints?

Focus Group Discussions

1. Some Reasons farmers might buy chemicals on their own: Rank them

A. Government supply is insufficient
B. Due to untimely supply of chemicals and other logistics
C. Due to the poor delivery of spraying gangs
D. Others specify……

2. **Some Reasons for failure to spray farms as required: Rank them**

A. Shortage of fuel
B. Shortage of spraying chemicals
C. Frequent Breakdown of spraying machines
D. Others (specify)……

3. Which of the following would you say is the greatest constraint facing your cocoa farming in the area?

A. Untimely spraying
B. Poor or bad weather conditions
C. Increase in pest and diseases attack
D. Others…….

4. Rank the following in order of priority, the conditions that contribute positively to good yield of your cocoa production in the area in recent years:

A. Increase in the number of times of spraying
B. Improved cultural practices undertaken
C. Good weather conditions
D. Timely spraying
E. Others……