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DEPARTMENT OF ECONOMICS

DETERMINANTS OF COCOA PRODUCTION IN THE ASHANTI REGION

BY

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DECLARATION

I wish to declare that the content of this work is the result of my effort through a survey and that the work has not been presented for any Certificate, Diploma or Degree elsewhere. Those whose work(s) were partly adopted are dully acknowledged in the text. I therefore present this for the award of Master of Philosophy (Economics) Degree.

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ABSTRACT

The economic benefits of cocoa in Ghana include foreign exchange, employment and provision of raw materials for both domestic and international industries. For these reasons, there has been a government intervention in the cocoa industry that brought forth policies including high producer price and also cocoa pest and disease control programme (CODAPEC) to stimulate cocoa production. However, studies investigating factors influencing cocoa production in Ghana are very scarce. This thesis fitted Ordinary Least Squares (OLS) and Weighted Least Squares (WLS) modelling techniques to cross section data obtained from 251 farmers. The respondents were selected using purposive sampling technique. Questionnaires were administered to respondents and the items consisted of farmers characteristics (production years, Gender, education) and farm characteristics (Farm size, family labour, hired labour, Farm age, fertilizer, mass spraying, insecticides, Total Revenue and type of seed). The dependent variable was output. The regression results showed an adjusted co-efficient of determination of 0.96. It was found that the total revenue and hired labour variables had significant influence on cocoa production. Both variables were significant at 1%. The number of times of mass spraying and farm size variables were statistically insignificant. This study could have important policy implication for government to increase producer price of cocoa.

LIST OF ABBREVIATIONS

C-D	Cobb-Douglas
CES	Constant Elasticity of Substitution
COCOBOD	Ghana Cocoa Board
CODAPEC	Cocoa Pest and Disease Control Programme
CRIG	Cocoa Research Institute of Ghana
FOB	Free On Board
GDP	Gross Domestic Product
GNA	Ghana News Agency
ICCO	International Cocoa Organization
LBCs	Licensed Buying Company
MoF	Ministry of Finance
NYEP	National Youth Employment Programme
ODI	Overseas Development Institute
OLS	Ordinary Least Squares
QCD	Quality Control Division
TR	Total Revenue
VIF	Variance Inflation Factor
WACRI	West African Cocoa Research Institute
WLS	Weighted Least Squares

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CHAPTER ONE

INTRODUCTION

1.0 Background Of The Study

In 1992, 59.9 % of the world's cocoa was produced by Africa, 25.5% by Latin America and the Caribbean and the remaining 14.6% by Asia and Oceania (Mossu, 1992). In the West African sub-region, cocoa is an important export crop in Cote d'Ivoire, Ghana, Nigeria, Cameroun, Togo and Sierra Leone . With current annual production of over 1,000,000 tonnes in Cote d'Ivoire and Ghana, the two West African countries account for over 40% of world cocoa supply (ODI, 2004).

In Ghana, cocoa occupies a key position in terms of foreign exchange revenues, domestic incomes, and employment. Cocoa contributed about 3.4% to Gross Domestic Product annually and an average of 29% to total export revenue between 1990 and 1999 (Anon., 2001) and 22% between 2000 and 2002 (Anon., 2003). The Ghana Cocoa Board (COCOBOD) signed a $1.5 billion pre-export trade finance facility for the purchase of cocoa for the 2010/2011 season. Ghana"s export earnings in 2007 amounted to $4,214 million in merchandise trade (14% annual increase, GNA 2008). For 2008, merchandise exports totalled $5,275.33 million. This shows a significant increase in the overall export earnings of Ghana in 2008 compared to 2007. The increase is mainly attributed to the rise in world price for cocoa (Economic Report Ghana, 2008) .

From 1910 to 1977 Ghana was the leading producer of cocoa with market shares ranging from 30-40% of the world's total production (Bateman, 1988). Production of cocoa peaked at 571,000 tonnes in the 1964/65 season. However, production fluctuated between 158,000 and 350,000 tonnes per annum up to 1988. By 1989 Ghana had lost her first position to Cote d'Ivoire in the production of cocoa in the world (Gill and Duffus, 1989). Ghana lost its first position because

production failed to take place on large scale in Ghana. Also, majority of cocoa farms in Ghana are small holdings owned by peasant farmers. For example, in Ghana, about 66% of farms are within the size range of 0-8 ha owned by 332,244 peasant farmers, with only 18.9% of the farms larger than 20 ha (Poku, 2009).

Few studies have identified several technical factors which have contributed to the dwindling cocoa production levels in Ghana (Adeyimi, in press, Ollennu *et al*., 1989; Anon, 1990; Osei, 1993; Anon, 1995; Freud *et al*., 1996). Paramount among these factors are the ravages caused by cocoa capsids (Heteroptera: Miridae) and diseases such as swollen shoot caused by cocoa swollen shoot virus and black pod caused by the fungi *Phytophthora palmivora* and *P. megakarya*. Other factors identified included bush fires and drought in Ghana during the 1980's.

The decline in cocoa production in Ghana in the 1980"s has raised a great deal of concern and in 1995, a high-powered committee comprising executives of the Ghana Cocoa Board, Ministries of Agriculture and Finance was charged with conducting an appraisal of the cocoa industry to identify the constraints to production and recommend measures for solving the problems with a view to arresting the decline in production (Anon. 1995). The committee recommendations were that there should be an increased producer price of cocoa and Cocoa Pest and Disease Control Programme (Popularly known as *mass spraying*).

Since 2000, the volume of cocoa produced in Ghana has grown at unprecedented rates at a yearly average of 16% between 2000 and 2003 interval (ODI, 2004). In the 2003/2004 production year Ghana recorded an output of over 600,000 tonnes (GNA, 2004) and by 2008/2009 Ghana had achieved an output of 710,000 tonnes. Many have attributed this significant increase in cocoa

production to the increase in producer price of cocoa from less than GH¢100 to GH¢200, fertiliser use and a government sponsored mass-spraying exercise beginning in 2001 (Vigneri, 2002).

Many studies like Sen (1962), Benjamin (1995); Teal and Zeitlin (2004) have been conducted regarding factors that influence the production of rice in India and Nigeria. In the same manner it is important for this study to investigate the determinants of cocoa production in Ghana with particular attention to the Ashanti region.

1.1 Statement of Problem

Between the 1980's and 1990's cocoa production fluctuated between 158,000 and 350,000 tonnes [Gill and Duffus (1989), GNA 2004]. The fluctuation and downward trend in the production of cocoa affected foreign exchange earnings. For example, figures released by COCOBOD showed that receipts from cocoa beans declined from 323.8 million dollars in 1990 to the lowest level of 295 million dollars in 1994. (GNA, 2004).

Therefore, the Ghana COCOBOD and stakeholders undertook measures such as the free cocoa spraying programme (mass spraying) and increased producer price of cocoa from GH¢70.00 to GH¢200.00 in an attempt to increase cocoa production in the country. Consequently, cocoa increased from 450,000 tonnes in the early 2000 production seasons to 710,000 tonnes in 2008/2009 (GNA, 2011). Currently, Ghana now produces an unprecedented volume of cocoa of over 1,000,000 tonnes (GNA, 2011).

Indeed, much is not known as to the specific factors that have contributed to this increase in output. Few studies have investigated the factors influencing cocoa production in Ghana. Edwin and

Masters (2003) tested the magnitude of correlation between cocoa yield and hybrid variety use in Ghana. They found that hybrid variety have higher output than the traditional cocoa types. Anim-Kwapong and Frimpong (2005) studied the impact of climatic conditions on cocoa production in the New Tafo Akim. They also reported that over 60% of the variation in cocoa produced could be explained by the preceding year"s total annual rainfall, total rainfall in the two driest months and total sunshine duration.

It is obvious from the studies mentioned above have evaluated limited number of explanatory variables and do not take into consideration the recent measures adopted by Ghana COCOBOD. Therefore, this study proposes to investigate cocoa production by extending the number of explanatory variables to capture the recent measures adopted by the Ghana COCOBOD. The variables included: farm size, family labour size, Hired labour size, fertilizer, mass spraying, Total revenue received by farmer from cocoa production, state of formal education and type of cocoa seed used in Ghana of which the focus is on Ashanti region.

1.2 Objectives Of The Study

General objective of the study aims at finding the determinants of cocoa production in the Ashanti region.

Specific objectives of the study include the following

- To identify the characteristics of cocoa producers in the Ashanti region.
- To measure the determinants of cocoa production in the Ashanti region.

- To examine the responsiveness of cocoa production to each of the determinants to be identified in the Ashanti region.
- To measure average cocoa income generated for farmers in the Ashanti region.

1.3 Hypothesis of the Study

- **Null Hypothesis (H_o)**

Farm size, family labour, hired labour, Farm age, production years, Gender, fertilizer, mass spraying , insecticides, education, Total Revenue and type of seed have no impact on cocoa production in Ashanti Region.

- **Alternative Hypothesis (H_1)**

Farm size, family labour, hired labour, Farm age, production years, Gender, fertilizer, mass spraying, insecticides, education, Total Revenue and type of seed have impact on cocoa production in Ashanti Region.

1.4 Justification of the Study

Few studies have been done on the production of cocoa in Ashanti region and in Ghana‟s Agricultural sector as a whole. Cocoa production has huge revenue implication especially in most developing countries like Ghana. Addressing the issue of poverty in Africa finds resonance in agricultural cocoa production effectiveness. The study will therefore provide the empirical evidence to policy makers in Ghana.

Further, the study helped to elucidate the constraints that cocoa farmers face in Ghana. Thus using the Ashanti region's cocoa sub-sector as a case study, the study elucidated the policy effectiveness in agriculture and inform governments and other aid agencies to budget in the agriculture sector

Moreover, the study suggests on how to treat policies affecting indicators like Farm size, labour size, fertilizer, insecticides, mass spraying and type of seed in Ghana and provide much clarification on cocoa production in the Ashanti region.

The study also adds to existing knowledge on Ghana‟s cocoa industry.

1.5 Brief Methodology

The Study had different model specifications. One of the Model expressed a linear relationship between cocoa production and all the determinants . It is emphasized that some of the variables like gender of farmer and type of seed used were dummies. This was done due to their qualitative nature. The second model used Weighted Least Squares. There was also Cobb-Douglas production function which aided in the estimation of elasticity with respect to the non-dummy variables.

The study was conducted in three different areas in the Ashanti region (Tepa, Bekwai and Kumawu). Purposive sampling technique was used to collect data from two hundred and fiftyone farmers. Data on price was obtained from COCOBOD.

1.6 Organisation Of The Study

The study is divided into five chapters .The chapter one looks at general knowledge and evidences as provided by existing literature. The chapter one also provides evidences on the need for this

study. The chapter two basically review the related literature to the production of cocoa in Ghana and other parts of the world like India and Nigeria. The chapter three concerns the methodology adopted throughout the study. The chapter four, moreover, provides detail analysis and corresponding interpretations and discussions with respect to objectives provided in the chapter one. The chapter five concentrates on policy economics. That is base on the findings from the study recommendations are made as well as conclusions drawn from the findings.

CHAPTER TWO

LITERATURE REVIEW.

2.0 Introduction

This chapter is about some selected production functions, empirical literature reviews (Selected Asian Countries, African countries and Ghana), nature of cocoa production in Ghana, economic importance of cocoa in Ghana, Major cocoa producing regions in Ghana and comparison of Ghana's output to major producers in the world. The selected production functions are briefly explained and demonstrated. The empirical literature review concerns what other studies have done in related areas to this study.

2.1 Production Functions

Production has been defined to be the output from the combination of inputs giving the level of technology. The production function shows the relationship between the various inputs used per period of time and the maximum quantity of the commodity that can be produced per period of time. The production function can be in a form of a table, a graph, or an equation showing the maximum output rate that can be achieved from any specified set of usage rates of inputs (Mansfield, 1970).

In mathematical form production function is often presented in the form below

$$Q = f(x_1, x_2, x_3, \ldots x_n) \quad \text{.....2a}$$

where Q is the output and x_1, x_2, x_3 up to x_n are the inputs for the production. Different types of production functions exist. But for the purpose of this work a critical analysis of the CobbDouglas (C-D) production and Constant Elasticity of Substitution (CES) production shall be considered.

2.2 Literature on Selected Production Functions • Cobb-

Douglas Production Function

If the production function has the form that is presented below

$$Q = f(K, L) = A K^r L^v \quad \text{.....2b}$$

then we say that it is a Cobb-Douglas production function. This is a two input production function where capital **K** and labour **L** are assumed to be the inputs of production. The magnitude of the production function does matter so these parameters are allowed to take arbitrary values. The parameter A measures, the scale of production (how much output is produced if we used one unit of each input). The parameters r and v measure how the amount of output responds to changes in the inputs **K** and **L** respectively.

Here the determinants of production is not just how much inputs are employed, but, by the responsiveness of output to changes in the inputs (capital and labour). Hence elasticity of the inputs (r for capital and v for labour) are very critical in determining the output level. The technology A has a larger role to play in this analysis. Hence as A increases then the function tends to be more efficient.

Many researchers have identified the C-D production function as being the most convenient because of its easier mathematical analysis and interpretation (Varian). The Cobb-Douglas specification is not well suited to handling inputs that often take a value of zero (Teal and Zeitlin, 2004).

- **Constant Elasticity Of Substitution (CES) Production Function**

The elasticity of substitution measures the percentage change in the least-cost input ratio resulting from a small percentage change in the input-price ratio. (Dowling,). In fact a C-D production function is a simplified version of the CES when the returns to scale is constant. In a case of two inputs say capital (K) and labour (L), the CES production function is given as

$$Q = A[\alpha K^{-\theta} + (1-\alpha) L^{-\theta}]^{-1/\theta} \quad \text{.....2c}$$

Where Q implies output, A is efficiency parameter, α is the distribution parameter denoting factor relative factor shares, ɵ is the substitution parameter determining the value of substitution and the parameters are such that A>0, 0<α<1 , and ɵ >-1 (Dowling).

It could be observed that the CES reverses back to *C-D* functional form whenever the substitution parameter (ɵ) is equal to one. Following this observation, one can conclude that the CES production function is heavily dependent on the level of technology (A- efficiency parameter). The CES production function also implies that output is not just determined by input combination, but level of technology. Therefore, the use of the C-D is synonymous to the use of the CES.

2.3 Empirical Literature Review

This section is presented in three parts. A review of empirical literature on selected Asian economies, selected African economies and Ghana.

2.3.1 Selected Asian Economies

Interest in determinants of production arose in the 1960s out of the observation that poor India farms yield are inversely related to farm size (Bhadan, 1973, Rao and Chotigeat, 1981, Deolaliker 1981).

Bhadan (1973) found a negative relationship between output per acre and farm size in both rice and wheat farms (monocrop situation) in India. He attributed the observed relationship to an inverse correlation between farm size and other inputs rather than scale diseconomies. His results show that smaller farms use more labour input per unit on land even when there is evidence of constant returns to scale. Moreover, when he fits on equation explaining the variations in labour use per unit of land across farms, he finds a significant negative relationship between labour and net area sown.

Rao (1981) used cross regional data from India, and found an inverse relationship between yields and farm size holds for traditional agriculture experiencing technological change. These results are confirmed by Rao and Chotigeat (1981). They show that land and labour have a negative effect on the elasticity of gross value of output per unit of land while capital has a positive effect.

Bhalla and Roy (1988) incorporated the effect of land quality into their analysis of the determinants of production. Their study proved that quality of land (soil) impacts significantly on production. Soil quality had positive impact on production and through that farmers who could afford to allow *Fallow Period* experienced increased production. In this regard production could be increased at the expense of virgin forest.

Bateman(1965) regressed production of coffee as a function of the lag price of producer price and soil humidity. Bateman used time series data in the estimation of the model. He found that prices have a serious positive impact on production. Soil humidity was also identified to have positive impact on coffee production.

According to Mamingi (1996), Agricultural production can be viewed in terms of aggregate production, sub-sectoral production and individual crop production. Bond (1983) concludes that both individual crop and aggregate crop production show a positive response to price. This positive relationship of agricultural production to price is shared by both developed and developing countries (Mamingi,1996). In support of these views, a paper by Gafar (1997) on how agricultural production respond to price in Jamaica, concludes on his econometric findings that agricultural production responds positively to price.

However, Bond (1983) was very sceptical when it comes to agricultural production in subSaharan African countries. He finds agricultural production to be unresponsive in the developing countries than the developed countries, and he attributes this to the fact that most of the farmers prefer leisure to income, after attaining a certain income target.

Nerlove (1956) believes that farmers react not to last year‟s price, instead to the expected price, and this expected price depends solely, to a limited extent, on last year‟s price. He, therefore, disagree with many authors who directly attribute current production to last year‟s price. To

Nerlove (1956) this error has accounted for too low production response to certain commodities.

Bond (1983) and Hattink et al. (1998) identified some factors affecting agricultural production which included poor transportation networks, inadequate research and extension facilities, unavailability of credit, shortages of fertilizer and other inputs, and lack of consumer goods on which the farmer can spend his income. However, Bond agreed on the difficulty involved in measuring these factors. To him considering only price effect on production will not give a true explanation of production.

Sloman (2006) argued agricultural production equation may relate current production only to prices in the previous periods because of delays which are incorporated in the process of production. This is typical of perennial agricultural products. For example this year‟s quantity of cocoa produced is a reflection of last year‟s price.

Kwinarajit and Gary (2004) measured the relative magnitude of the key economic factors affecting Thai rice producer planting decisions using an econometric model. They found that area planted to rice in Thailand is more responsive to changes in area planted in previous years, the amount of rainfall, and the availability of agricultural labor than to changes in paddy rice prices. They explained that an important implication of the study was that policies to reduce rural labor shortages could do more to enhance the production of rice in Thailand than annual adjustments in the level of the guaranteed price of rice received by producers.

2.3.2 Selected African Economies

Agbeniyi et al. (2006) used the logistic (logit) probability model to estimate the relationship between the use of fertiliser and cocoa production in Nigeria. They treated fertiliser use as a dependent variable of which they regressed on other factors such as age of farmer (years), level of education of farmer, household size, farm size (hectares), association membership of farmers and cocoa output (tonnes). They found that how much fertiliser is used was heavily determined by the level of education. Those with higher (Tertiary education) levels of education were found to have a higher efficiency in the use of fertiliser.

Ojo and Ehinmowo (2010) employed a stochastic frontier production function analysis to; examine the productivity, predict the technical efficiency of Kola-nut production in Ondo State, Nigeria, and to identify the factors affecting production, profitability, productivity and technical efficiency (TE) using farm – level survey data collected from 150 Kola-nut farmers selected using multistage sampling technique assisted with interview schedule. Findings from the study showed that Kola-nut farmers operated on a very small-scale level and the kola trees are quite old but the enterprise is still very profitable. The productivity analysis shows that while number of kola trees, cost of chemical and labour were efficiently utilized it was not the case with farm distance and age of kola trees whose utilization was already in the stage three of the production region. The return to scale (RTS) of 1.155 shows that Kola-nut production was in the irrational stage of the production surface. Kola-nut production could therefore be increased by massive replacement of the old kola trees with new ones as well as putting more hectares to kola-nut production.

2.3.3 A Case of Ghana

According to Anim-Kwapong and Frimpong (2005), agricultural production is heavily dependent on the soil quality and weather. According to Analysis of impact of climate change on cocoa production by Anim-Kwapong and Frimpong (2005), multiple regression analysis showed that over 60% of the variation in Cocoa produced could be explained by the combination of the preceding year‟s total annual rainfall, total rainfall in the two driest months and total sunshine duration. Examination of the standardized residuals against the fitted values showed that the model adequately fitted the data. However, the histogram of residuals showed clearly that factors

other than those in the model had significant influence on the results as indicated by the value of the regression coefficient of determination (R^2) of 0.61.

Teal et al (2004) identified cocoa price as another determinant of cocoa production in Ghana. That is the output price of cocoa has effect on production decisions. However, Teal et al (2004), found that the output price of cocoa has a long run effect on production rather than a short run production.

Teal and Vigneri (2004), identified that the production of cocoa estimated is of the CobbDouglas form. The variables used included the fraction of paid workers employed by farmer at a particular time, productivity-enhancing inputs (such as use of insecticide, government spray machines), local institutional variables and farmer characteristics hypothesized to influence productivity. Controls for the region were included in local institutional variables. Under this specification coefficients corresponding to logarithmic variables can be interpreted as elasticity.

The parameters of this specification were estimated by Ordinary Least Squares (OLS). The study found that coefficient of farm size is significantly below unity.

Teal and Vigneri (2004) and Zeitlin (2005), however, noted that the Cobb-Douglas specification is not well suited to handling variables that often take a value of zero since one cannot take the logarithm of a variable used when it takes a value of zero. In the work of Teal and Vigneri (2004) and Zeitlin (2005), it was found that Instrumental Variables (IV) approaches can identify a stronger effect of additional labour on production. This suggests that small point

estimate on labour inputs may be caused by attenuation bias, as this input tends to be measured with relative imprecision. Fertilizer used had a strong economic and robust statistical effect in the analysis. Indeed, this result closely parallels the finding of Teal and Zeitlin with respect to input expenditure.

Edwin and Masters (2003) tested the magnitude of correlation between cocoa yield and hybrid variety use in Ghana. They used two stage least squares (2SLS) method in their estimation process. In this study they categorized varieties of cocoa seeds into two groups. Following local usage, they categorized all pre-1980 varieties as "traditional", and refer to all later releases as "new". Results showed that hybrid adoption is closely correlated with yield, increasing yield by at least 51 percent, and cocoa yield increases with fertilizer use. Interaction effects between variety adoption and input use were not significant, indicating that the productivity of new varieties is not conditional on input use, but tree age is clearly significant particularly when entered as age squared, indicating that yields decline mainly at high levels of age.

According to the Ministry of Finance, (1999), in early 1980, Ghana experienced a devastating bushfire and drought in the south and also infestation by cocoa swollen shoot virus (CSSV) in the East that led to government-enforced cutting of cocoa trees, particularly the older ones. The ministry believed these experiences of the country accounted for the low levels of production in Ghana in the 1980's.

Gyimah-Brempong and Apraku (1987) estimated a production function of cocoa in the logarithmic form to account for elasticity. In their analysis elasticity with respect to world price and domestic price of cocoa were determined. In their study too time series data was modelled in a Cobb-Douglas production function. This implies that logarithmic transformation was significantly used to aid in the linearization of the model. They found that production was very responsive to price changes both local and international.

Poku (2009) analyse agricultural production and pricing policy nexus: a reflection of the Ghana cocoa industry. Previous studies on the effect of government intervention policy in affecting cocoa production have been based solely on price policy, and some have been too descriptive. In Poku (2009) analysis, an attempt was made to consider both the effects of price and production policy on cocoa supply and wealth of the farmer. Poku (2009) results showed that real producer price which is a proxy for price policy influence farmers‟ decision in allocating their resources to the production of cocoa. Farmers double up their effort in pruning, weeding and spraying in the short-run, if real producer price is very motivating. Therefore, the higher the producer price, the more farmers would be willing to allocate their resources to the production of cocoa. The results also

indicate that farmers plant more trees of cocoa to increase supply in the long-run, as a result of high real producer price.

Further, Poku (2009), showed that the coefficient of CODAPEC was significant but has the wrong sign. However, the possibility of other non-price factors and constraints in the marketing system could not be underestimated. There was also evidence that the speed of adjustment to long run equilibrium was very high.

2.4 Nature of Production: Cocoa In Ghana

Cocoa production is carried by smallholder farmers, who normally grow food crops alongside the cocoa cultivation. Cultivation is done using simple tools like cutlass, and sometimes hoes for the land preparation ahead of the seedlings planting. Normally the seedlings are nursed by the subsistence farmer himself, but formerly it was supplied by the cocoa research institute of Ghana. In choosing the site for the farm, the farmer usually selects a place which is a little bit far in the bush to reduce disturbances to the yield of the cocoa tree (Tudhope 1909).

The bush is cleared in the same manner when the land is being prepared for the cultivation of food crop: clearing of weeds leaving few large trees standing, heaping and burning of the weeds. Larger trees are left to give shades to the new seedlings. In addition, the farmer starts by planting foodstuffs such as cocoyam, plantain. The young seedlings are then planted alongside the food crops. These are done to give a little bit of shades to the cocoa seedlings, since the young seedlings does not require too much of intense heat from the sun. Planting is carried out using the hoe, and sometimes the cutlass. After planting, maintenance needs to be observed even at fruit bearing stage.

The cocoa tree takes about 3-5years to bear fruit, depending on the variety. There are three main types of varieties of cocoa cultivated in Ghana: Amelonado, Amazonia and Hybrid. The Amelona and the Amazonia take about 5 years to bear fruit unlike the hybrid which requires only 3 years of gestation period (COCOBOD 2009; Tudhope 1909).

Within this period, maintenance is carried out by the farmer to ensure good yield. In this case, the farmer bore the cost of spraying, fertilizing, maintenance and weeding of the farm himself. However, according to Tudhope (1909), many well to do farmers give their farm on contract to caretakers to manage. In that instance, the caretaker takes the responsibility of maintaining the farm whilst the owner gives expenditure out to the caretaker to carry out weeding fertilizing and spraying of the farm. This goes on till the harvesting time (which is determine by the yellowish nature of the cocoa pods), when the yield is divided into three, where the caretaker receives onethird of the crop, while the remaining two-thirds goes to the owner. In the Ghanaian language, it is called "*Abusa*", meaning division into three. In some communities, the owners pay some fixed proportion of the harvest to the caretaker (MOF 1999)

After harvesting, which is usually done with cutlass, the pods are broken by means of cutting it into two with a cutlass or hitting it against a stone. The beans are then gathered and heaped in the farm for about 7 days to ferment before it is carried to the house for drying. It is then bag in 62.5kg, which is sold to the Licensed Buying Companies, which have their purchasing clerks in the rural areas.

2. 5 Comparison of Yields In Ghana With Other Major Producers

Ghana‟s yield in the cocoa sector has not been encouraging when head-to-head comparison is made with other major producing country like Cote d‟ Ivoire. Ghana's output as at 1999 was 30% below that of Cote d‟Ivoire, while on the average, it fell 13% below that of the Africa continent (MOF 1999). Two main reasons have been identified for this down trend. The first reason is due to the old nature of significant percentage of the cocoa-tree stock (Anim-Kwapong and Frimpong, 2005) and the second reason has been given by MOF (1999) as the poor yielding of the variety of the cocoa tree. Most of the tree stocks, are of the Amazonia and Amelonado varieties, which have a lower yield as compare to the hybrid.

Moreover, most major producing countries make use of better modern technology which supersedes that of the method used in Ghana. Majority of farmers hardly make use of fertilizers and pesticides. This situation has calmed down with the introduction of the mass spraying programme in 2001/02 (Anim-Kwapong 2005; MOF 1999).

The characteristics of cocoa production in Ghana seem to merge with other producing country like Cote d‟ Ivoire when emphasis is placed on the type of soil and climate. Both countries have the same climate and soil type. All the cocoa growing areas lie in the forest belt. The difference in yield may, therefore, be attributed to the level of input application, the old nature of the trees, farmers‟ adherence to maintenance, and the acres of land farmers cultivate. Cultivation in Ghana has been on a smaller scale, and various attempts to embark on plantation in the 1970s were failed as a result of difficulty in acquiring land, and in addition shortage of labour (MOF 1999).

The smaller scale of Ghana's cultivation of cocoa was persistent until the early 2000. For instance in 1999/2000 production year Cote d'Ivoire had an output of about 1,409,000 tonnes whiles Ghana produced about 437,000 tonnes whiles Indonesia produced 410,000 tonnes.

The production continued to lag behind Cote d'Ivoire and later even becoming a traitor to Indonesia in the production of cocoa. Whiles Cote d'Ivoire produced 1,212,000 tonnes in 2000/2001, 1,265,000 in 2001/2002, and over 2,000,000 tonnes in 2008/2009, Ghana produced 395,000

tonnes, 341,000 tonnes and less than a million of a tonne in the respective years that Cote d'Ivoire continued to increase production significantly. The situation for Indonesia had improve from 392,000 tonnes in 2000/2001 to 455,000tonnes in 2001/2002 production year (ICCO :2002, 2005, 2006, 2008).

From the statistics given, it is clear that apart from Cote d'Ivoire that is so much distinct in the production of cocoa, Ghana and Other countries like Indonesia have enjoyed close levels of production in the world's cocoa industry.

2.6 Economic Importance of Cocoa to Ghana

One of the contributions of the sector is employment generation in Ghana. 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 to 4.0 hectare with an estimated total cultivation area of about 1.45 million hectares (COCOBOD, unpublished data).

Also the sector contributes greatly to foreign exchange earnings in Ghana. Figures released by COCOBOD showed that receipts from cocoa beans amounted to 323.8 million dollars in 1990 and to 295 million dollars in 1994. It picked up again in 1995 and hit another high of 541.59 million dollars in 1998, but slipped to 379.95 million dollars in 2000. (GNA, 2004). The cocoa sector contributed about 3.4% to foreign exchange earnings of Ghana on the average between the periods of 2001 and 2006 (Padi and Owusu). In 2002 for instance, cocoa made up for 22.4 percent (463 million US $) of the total foreign exchange earnings. Cocoa constituted 63% of the export earnings from the agricultural sector, compared to 25% and 12% contributed by timber and the non-traditional export sectors (ISSER, 2003).

Moreover, the sector provides income to the farmers and other stakeholders. For smallholder cocoa farmers, cocoa contributes about 70-100% of their annual household incomes (GNA, 2009). In addition other stakeholders like chemical companies, input distributors and licensed cocoa buying companies (LCB‟s) also depend largely on cocoa for markets for their products, employment and income (Asamoah and Baah, 2002).

2.7 Major Cocoa Producing Regions In Ghana

There are six cocoa growing regions in Ghana namely Ashanti, Brong-Ahafo, Central, Eastern, Western, and Volta regions. The main cocoa-producing region is presently the Western Region, which stands for more than 50% of total annual production (COCOBOD, 2004).

The Ashanti region was initially the leader in terms of cocoa production since the 1960's until 1984/1985 production when there was a change in production leadership from the Ashanti region

to the Western region. In 1969/1970 production year the Ashanti region produced 125,406 tonnes, whiles Brong Ahafo, Central region, Eastern region, Volta and Western region produced 115,393 tonnes, 55,236 tonnes, 69,431 tonnes, 20,878 tonnes and 31,113 tonnes respectively. As stated earlier the Ashanti region took the lead in cocoa production until 1984/1985 production year. In 1984/1985 Ashanti region produced 44,928 tonnes whiles Brong Ahafo, Central region , Eastern region, Volta and Western region produced 28,756 tonnes, 19,070 tonnes, 28,540 tonnes, 1,028 tonnes and 52,487 tonnes respectively (COCOBOD, 2004). Table k* at the appendix provides detail of the regional performance in the production of cocoa in Ghana.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter is in three parts: Model specification, Data and variable description and Description of the study area. The model specification included OLS, WLS and logarithmic estimation and statistical tests. The data and variable description included source and type of data, sampling technique, data collection, data analysis and variable description.

3.1 Model Specification

Different estimation procedures were combined in the analysis. The estimation methods used include Ordinary Least Squares (OLS) and Weighted Least Squares (WLS). Cocoa production was expressed as a function of farm size, hired labour size, family labour, usage of fertilizer, Total revenue from cocoa in 2009, Age of farm, number of times of mass spraying and type of seed. Mathematically the function is stated as

$$Q_{10jth} = w\ (F_{10jth}, L^{h}_{10jth}, L^{f}_{10jth}, A_{10jth}, Z_{10jth}, M_{10jth}, S_{10jth}, E_{10jth}, G, TR_{09jth}) \quad \text{.....3a}$$

$$TR_{09jth} = \mu(P_{09}, Q_{09jth}) \quad \text{.....3b}$$

where: Q_{10jth} = cocoa output in bags by the *jth* Farmer in 2010, F_{10jth}= Farm size in acres by the *jth* Farmer in 2010, L^{h}_{10jth}= hired labour size by the *jth* Farmer in 2010, L^{f}_{10jth}=family labour for the *jth* Farmer in 2010, A_{10jth}=Age of farm for the *jth* Farmer in 2010, Z_{10jth}= usage of fertilizer by *jth* Farmer in 2010, M_{10jth}=Mass spraying , S_{10jth}=Type of seed used by *jth* Farmer as at 2010 (o for no hybrid seed, 1 for hybrid seed) , E_{10jth}= Education level of *jth* Farmer as at 2010 (0 for no formal

education, 1 for formal education) G = Gender (0 for female, 1 for male) and TR_{09jth}= Total revenue of the *jth* farmer in 2009.

This work is an attempt to model the production function of cocoa production in the Ashanti region with reference to the aforementioned factors in consideration. This study extends the above idea of production to include some primary factors that determine production. These primary factors include farm size, hired labour size, family labour, age of farm, usage of fertilizer, mass spraying and type of seed.

According to Eicher and Baker (1985), different studies use different models depending on the data available and the objectives of the study. The Cobb – Douglas production function is used to estimate the elasticity of production with respect to farm size in acres, hired labour size, family labour , age of farm, bags of fertilizer used, number of times of Mass spraying per production season and Total revenue. The Cobb – Douglas production function (CDPF) is used because of its simplicity and applicability . Also, the choice of the Cobb – Douglas Production

Function (CDPF) is to aid in the estimation of the responsiveness of production of cocoa to changes in each of the factors already mentioned above. There is, moreover, an estimation of a Non-Logarithmic Linear Model (NLLM). The non-logarithmic linear model enabled the capturing of variables that have dummies.

3.1.1 Non-Logarithmic Linear Model (NLLM): Ordinary Least Squares (OLS)

In addition to the basic agricultural production inputs such as land, labour, and fertiliser, a number of factors such as Mass spraying and type of seed have been used in the estimation process. In this estimation there is the estimation of all variables in a Non-Logarithmic Linear Model (NLLM)

$$Q_{10jth} = \beta_0 + \beta_1 F_{10jth} + \beta_2 L^h_{10jth} + \beta_3 L^f_{10jth} + \beta_4 A_{10jth} + \beta_5 Z_{10jth} + \beta_6 TR_{09jth} + \beta_7 M_{10jth} + \beta_8 S_{10jth} + \beta_9 G + \beta_{10} E_{10jth} + e \quad \text{.....3c}$$

$$TR_{09jth} = P_9 * Q_{09jth} \text{.....3d}$$

where all variables remain as already defined and e = error term

The soil quality of different farms is believed to cause important variations in the effect of farm size on agricultural production (Berry, et al. (1979); Lamb (2003)). This study seeks to control for this by using the self-reported value of cocoa holdings as a proxy for land quality. Moreover, the above equation [eqn (3c)] explicitly accounts for the effect of Total Labour Employed (TLE). This is because in most of the traditional cocoa farms, farmers dwell partly on family labour and some cases employ labour from outside the family.

3.1.2 Weighted Least Squares (WLS)

This section looks at the weighted form of the OLS equations. The OLS equation for the non-logarithmic linear function was re-estimated with the weighted least squares.

Hetereoscedasticity test with Gledjser and Breusch-Pagan tests suggested a transformation factor of $\frac{1}{\sqrt{(TR9)^4}}$. The weighted least squares for equation (3c) is as shown below

$$\frac{Q_{10jth}}{\sqrt{(TR_{09jth})^4}} = \frac{\beta_0}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_1 F_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_2 L^h_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_3 L^f_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_4 A_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_5 Z_{10jth}}{\sqrt{(TR_{09jth})^4}}$$

$$+ \frac{\beta_6 TR_{09jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_7 M_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_8 S_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_9 G}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_{10} E_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{e}{\sqrt{(TR_{09jth})^4}}$$

The application of the weighting factor through non-logarithmic linear function had the numerator of the Total revenue factor cancelling out. Thus, by mathematical simplification gave

$$\frac{Q_{10jth}}{\sqrt{(TR_{09jth})^4}} = \frac{\beta_0}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_1 F_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_2 L^h_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_3 L^f_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_4 A_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_5 Z_{10jth}}{\sqrt{(TR_{09jth})^4}}$$

$$+ \frac{\beta_6}{(TR_{09jth})} + \frac{\beta_7 M_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_8 S_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_9 G}{\sqrt{(TR_{09jth})^4}} + \frac{\beta_{10} E_{10jth}}{\sqrt{(TR_{09jth})^4}} + \frac{e}{\sqrt{(TR_{09jth})^4}} \quad \text{..... .....3e}$$

It could be seen that the above have the weight factor being applied through.

3.1.3 Logarithmic Specification

Accordingly the basic logarithmic regression specification to be estimated is as follows; thus to enable regression, there shall be introduction of logarithm into the Cobb-Douglas production function. Hence introducing natural $\log_e$ (ln).

$$\ln \frac{Q_{10jth}}{F_{10jth}} = \Omega_0 + \Omega_1 \ln + \Omega_2 \ln L^h_{10jth} + \Omega_3 \ln L^f_{10jth} + \Omega_4 \ln A_{10jth} + \Omega_5 \ln Z_{10jth} + \Omega_6 \ln TR_{09jth} + \Omega_7 \ln \frac{M_{10jth}}{} + v \quad \text{.....3f}$$

where Ω_0, Ω_1, Ω_2, Ω_3, Ω_4, Ω_5, Ω_6, and Ω_7, = parameters to be estimated. It should be noted moreover, that Ω_1, Ω_2, Ω_3, Ω_4, Ω_5, Ω_6, and Ω_7 are the elasticity with respect to F_{10jth},

L^{f}_{10jth} , A_{10jth}, Z_{10jth}, TR_{09jth} and M_{10jth} . The logarithm was introduce to:

- Help to linearalize the model
- Help eliminate econometric problems such as Hetereoskedasticity, and
- Enable easier determination of the responsiveness of production to changes in the independent variables.

3.1.4 Tests

The Durbin-Watson (DW) statistic was used to test the presence of Autocorrelation of the disturbance term. Since the study is a cross sectional study different tests like Breusch-Pagan test and the Gledjsers tests was used to test for Hetereoscedasticity. The F – test was used to test the overall significance of the independent variables at an alpha level of five percent (5%). Besides, the t–test was performed to test the individual significance of the various variables involved. The R^2 Adjusted (Co – efficient of determination Adjusted) was also used to explain explicitly, the proportion of the behaviour in production explained by the independent variables.

3.2 Data and Variable Description

This section includes source and type of data, sampling technique, data collection and data analysis. Moreover, the section also provides description of the variables as used in this study.

3.2.1 Source and Type of Data

The study used both primary and secondary data. The data on price were obtained from COCOBOD and other sources like the Ministry of Food and Agriculture and Ministry of Finance and Economic planning. The primary data were obtained from the selected cocoa farmers in the Ashanti region who responded to a set of questionnaires.

This study relied purely on cross sectional data. This was necessitated due to farmers inability to provide values on their activities for the period that are old enough. Moreover, the study was structured in such a way that data collected featured farmers characteristics such as age of farmer, years of production, education, marital status and family size.

3.2.2 Sampling Technique

Purposive sampling method was used to solicit information from cocoa farmers. This is because the study was interested in only cocoa farmers. Based on this, the sample size was selected by taking into consideration the population in the sample area.

The study did not target the number of each gender it was to sampled. By implication , the study could not control the number of males or females to be sampled. However, upon this approach used for the study, extra care was taken to avoid respondents that were below eighteen years but own cocoa farm(s). This strategy was to aid the study to estimate the production function for only those in the legal working age according to the Ghana constitution.

3.2.3 Data Collection Method

The study was conducted in three villages in two municipalities and a district. Questionnaire was administered, consisting of 31 question items to 251 respondents comprising 80 respondents from Bekwai and 91 questionnaires to cocoa farmers in Tepa. The rest (80) of the questionnaire were administered to respondents in Kumawu. The information solicited from the farmers include demographic characteristics, the mass spraying exercise, type of seed, number of times insecticides is used, output per year , farm size, family labour and hired labour. In addition to the primary data, secondary data on producer price per bag of cocoa was obtained to aid the study.

Information on the mechanisms of the cocoa industry was solicited from COCOBOD. Data on cocoa producer price was obtained from the COCOBOD.

3.2.4 Data Analysis And Interpretation

The data was analyzed with the STATA, a Statistical Package . This aided in the regression process. The STATA was used because of its ability to analyse both primary and secondary data. The STATA also helped in performing most of the econometric analysis. Graphical interpretation of the variables involved are used significantly. This in essence aided in descriptive analysis.

3.2. 5 Variables Description

The Anim-Kwapong and Frimpong (2005) used Output as the dependent variable. In the same way Poku (2009) used output as dependent in his analysis. This study also uses output as the dependent variable. Whiles the aforementioned studies measured output in tonnes, this study measures output

in terms of bags of cocoa produced per farmer. The independent variables in the model are described as follows.

- **Farm Size**

This refers to the coverage of the farm. Note that different units of measurements are used by different researchers which includes hectare, acre, kilometers and miles. Very common among farmers in the Ashanti Region is the use of the acre as measuring the farm size. Therefore this study adopts the use of acre as measuring the size of farm possessed by farmers.

- **Hired Labour**

Labour is defined as the human effort both physical and mental that is used in the production process. It is imperative for this research to distinguish between hired labour and family labour. Hired labour by the paradigm of this study refers to the labour the farmer employs from outside his or her family. Also, it should be noted that only the labour force above eighteen years are take into account.

- **Family Labour**

This refers the labour force the farmer employs from the nuclear family. It is again emphasized that only the labour above eighteen years are taken into consideration.

- **Farm Age**

This take account of the period the farm has been in existence. This variable is basically captured in years.

- **Type of Seed**

This variable looks at the impact of the different cocoa seeds on output level. The study tries to capture this variable in two forms (Traditional and Non-Traditional). The Traditional seed are described by the study to the type that was introduced by Tetteh Quarshie (Amelano Type) . The hybrid type are the cross breeding ones through scientific research. Besides the two groups a descriptive statistics shall be provided to show those who grow both types of seeds.

- **Total Revenue**

This refers to the income the farmer gets from the output he produces. The effects of price could not be captured separately because of collinearity. In place to this the total revenue was introduced to see how the farmers respond to prices through the total revenue. This is obtained by multiplying the producer price per bag of cocoa by the number of bags produced by the farmer.

$$TR_{09jth}=P_{09}*Q_{09jth}$$

where TR_{09j} is the total revenue obtained in 2009 by the *jth* farmer and Q_{9j} is the output by the *jth* farmer in 2009.

- **Mass Spraying**

This is a national exercise carried out for cocoa farmers every year. This is an attempt to provide free spraying for farmers. Since its inception in 2001 the objective has been to fight cocoa diseases through effective spraying so that national output would swell in the end. It is important to note

that separate units of mass spraying has been established in most of the cocoa growing areas in the Ashanti Region. With this variable the number of times the farmer enjoys that is taken into account.

- **Gender**

Here the sex of the farmer is brought into repute. The basic idea is to see the participation of males and females in cocoa production and their levels of production. Male is given a dummy of one whiles females are given a dummy of zero.

- **Educational Level**

This is the academic achievement of the farmer. The basic idea behind this is to find out the class of people (formally educated or non-formally educated) who go into cocoa production and their respective impacts.

3.3 Study Area

Ashanti is an administrative region in central Ghana. Most of Ghana's cocoa is grown in Ashanti. The Ashanti Region is subdivided into 27 districts. The region accounts for about 19.5% of total population in Ghana representing 4,725,046 of a total population of 24,223,431. By this figure the region continues to be the populated area in Ghana (2010 Population and Housing Census in Ghana, Provisional Results).

The dominant occupation in the region is agricultural production. Some of the crops grown in the region includes cocoa, maize, yam, plantain and cassava. The region dominated the production of

cocoa in Ghana until it was over taken by the Western region in 1984/1985 crop season. The region has since then trail behind in the production of cocoa in Ghana. However recent government policies in the cocoa sector such as increase in producer price of cocoa has seen some revival from Ashanti region in terms of cocoa production even though it still lags behind Western region in the production of cocoa in Ghana.

The production of cocoa is distributed across the length and the breadth of the Ashanti region. This is so because of the good distribution of rainfall in the region. Availability of arable lands in the region has also accounted for the relative predominance of cocoa production in the region. But for the purpose of this study, two municipal areas and a district have been selected for the study. These areas are Bekwai Municipality, Tepa Municipality and Sekyere Afram Plains (Kumawu) District. These areas are chosen because they are major areas in terms of cocoa production in the Ashanti region.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

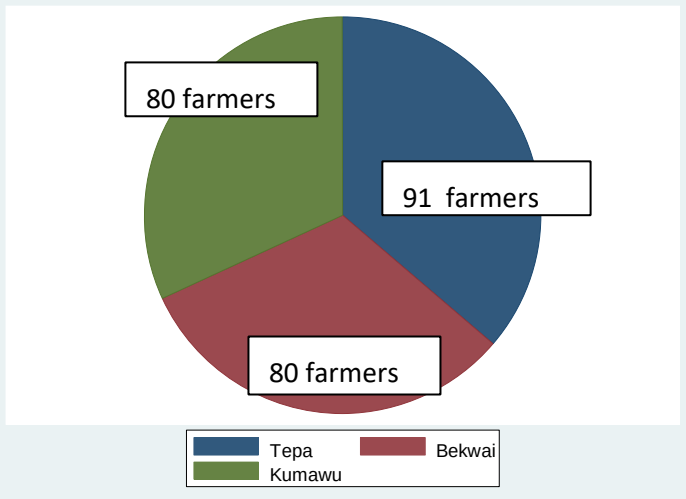
In this chapter the results of the study are presented. There are two parts: descriptive analysis and regression analysis. The descriptive analysis provides information on geographical composition of respondents, and farmer‟s characteristics. The regression analysis shows results from Ordinary Least Squares, Weighted Least Squares and logarithmic specification.

4.1 Descriptive Analysis

- **Geographical Composition of Respondents.**

In all two hundred and fifty one (251) respondents were sampled across the region. Out of this number, ninety-one (91) of the respondents were from Tepa Municipality, Eighty (80) from Bekwai Municipality and eighty also from the Sekyere Afram Plains district (Kumawu). The pie chart below shows the geographical Distribution of the respondents.

Figure 4.1: A Pie Chart On Geographical Distribution Of Respondents.



{Source: Author's Construction}

The actual target of the study was to use hundred respondents from each area. However, the data provided by some of the respondents were not in full and therefore would have to be dropped. Forty-nine observations were dropped from the study.

- **Farmers Characteristics**

Table 4.1 below illustrates the distribution of respondents by gender.

Table 4.1:The Distribution of Respondents By Gender.

Gender	Actual Number	Percentage
Male	171	68
Female	80	32

{Source: Author's Construction}

Table 4.1 shows that a lot of males were covered in the study than females. Males stood at 171 which represented 68% of valid respondents. Females were 80 in number which is 32% of valid respondents.

Production experience of respondents was captured as in the number of years a farmer has been in the production of cocoa. Table 4.2 shows that on the average the farmer‟s experience stood at 2.04 years in the production of cocoa. However, it could be observed that the farm age is 14.85 years. Therefore, the implication is that some of the farmers inherited the cocoa farms. This is presented in Table 4.2 below

Table 4.2: Summary of Farmers and Farm Characteristics

VARIABLES	Mean	Standard. Error.
Production Years of Farmer	2.043825	.0449024
Farm Age By 2010	14.84861	.5252849
Farm Size By 2010	8.159363	.4534617
Hired Labour In 2010	5.816733	.4616887
Family Labour In 2010	3.737052	.1419638
Fertilizer Bags In 2010	6.60757	.5230252
No. of Times Insecticides Is Used, 2010	2.880478	.1109477
Numb Of Times Mass Spray 2010	1.976096	.0625942
Output Of Cocoa, 2010	10.63147	.7452175
Total Revenue,2009	1360.914	95.0575

{Source: Author's Construction}

Table 4.2, furthermore, shows that the farm size of respondents as at 2010 was on average, stood at 8.16 acres. But farmers had farm size ranging between one (1) acre and fifty (50) acres. This means that farmers capacity to cultivate cocoa differs across the region. The difference in the capacity may be accounted for by the differences in resource level. These resources may include money for the purchase of land, payment of labour hired and accessibility of arable lands and

rainfall.

Table 4.2 also indicates that farmers on the average hired labour for 5.82 times which is approximately six (6) times of labour hours (called *By-Day* in local parlance). That is farmers attempt to supplement their labour hours spent on the cocoa farm by hiring labour. In this case they have the number of hours which the labour hired must work to attract specific wage.

According to the respondents the hired labour work from 7:00am to 12:00pm for a wage of GH¢9.00. According to some farmers they find it difficult to hire this labour since they perceive it to be expensive.

Table 4.2 again indicates that farmers sometimes supplement hired labour with family labour (i.e. the members of the nuclear family who are at least eighteen (18) years). From Table 4.2 approximately four (4) members of respondents nuclear family work on the farm (This figure from the table is 3.737052 but since we do not have a decimal in labour the approximate value of four (4) members is used). That is within the farmers family members who are 18 years and above are made to help on the farm. Here the number of members is being used but not the number of hours.

Moreover Table 4.2 shows that on the average 6.60757 bags of fertilizer were used by farmers. This number does not imply the number of bags used per acre. But the number of bags the farmer uses on his entire farm. This number of bags is too high for smaller farms as explained by the COCOBOD. The ideal number of bags per acre is estimated to be at most two bags.

However, the average number of bags of fertiliser per farmer at least corresponds this average farm size of 8.16 acres.

Table 4.2 in addition shows that the number of times insecticides is used on the average is 2.88. Which means that in the production year, farmers used insecticides on their farm at an average of three (3) times. Farmers made it clear that some of the insecticides they use are relatively expensive and therefore are not able to afford its purchase. Moreover, some farmers explained that they refuse to do that because of the mass spraying availability. Ideally, five times is recommended for a production season.

Free cocoa spraying exercise introduced in the 2000 farming season was also evaluated. Out of the total number of respondents approximately 99% had heard of the mass spraying exercise whiles at most 1% said they have not heard of it before. From Table 4.2 farmers received mass spraying of 1.97 times on the average, which is approximately two (2) times. This supplement the farmers own spraying of three times per production season.

From Table 4.2, output was 10.63 bags on the average which is approximately equal to eleven (11) bags of cocoa per farmer. This value compared to the average farm size of 8.16 acres, gives 1.31 bags of cocoa per acre. The COCOBOD declared that when good farming practices are put into practice , an acre is able to yield at least 4 bags of cocoa. This means that the average output of the farmers is smaller relative to their average farm size.

Table 4.2 indicates that on average a farmer obtained GH¢ 1360.94. Notice that it is this average income that the farmers make all necessary expenditures on the farm including the family expenditure. Farmers are therefore detrimental in this regard since, their income levels are smaller relative to other workers in other sectors of the economy.

4.2. Regression Results and Analysis

- **OLS Results of Linear Regression**

The regression specification provides a co-efficient of determination (R^2) of 96.97% and adjusted R^2 of 96.82%. That is the linear regression specification of the dependent variable (output) is being explained up to at least 96.82% by the independent variable. From the F- test, at error levels of 1%, 5% and 10% the parameter estimates are considered to be significant with 239 degrees of freedom. It presupposes that all the independent variables are able to explain the dependent variable (output). The regression results is provided in Table 4.3.

Table 4.3: Regression of Output on All Explanatory Variables (OLS).

VARIABLES	Coefficients.	T-statistic	P-Value
Production Years Of Farmer	-.3834845	-1.31	0.192
Farm Age By 2010	-.0230766	-0.98	0.328
Farm Size, 2010	.1148967	3.69	0.000*
Hired Labour, 2010	.0865727	3.46	0.001*
Family Labour, 2010	-.0755879	-1.14	0.257
Fertiliser Bags, 2010	-.0027504	-0.12	0.906
No Of Times Insecticides , 2010	-.0645701	-0.74	0.458
No Times Mass Spraying, 2010	- .0051089	- 0.03	0.972
Table 4.3 CONT'D			
Total Revenue, 2009	.0072237	46.92	0.000*
Male	.2863586	0.98	0.330
No.edu	.9130537	3.12	0.002*
Hybrid Seed	.3598788	1.08	0.283
Constant	.27158	0.41	0.685

*{Source :Author's Construction} * Statistically significant at 10%, 5% and 1% error levels*

From Table 4.3, it is self evident that determinants such as production years (farmers experience), farm age, family labour, bags or fertilizer used and number of times insecticides is used had a negative impact on output.

The production years variable was found to be negatively related to output and this, from the study could be explained by the fact that farmers are growing old and therefore the strength and impact on production declines. This in fact, is in tandem with the works of Deolaliker (1983), Rao and Chotogeate (1964) who had identified in India that production levels in rice farms are going down simply because of ageing farmers working on ageing farms.

Most of the respondents (farmers) were also found to have sent their wards to school. And by that proposition, those who were relying heavily on family labour had negative impact on production. Social loafing on the part of family members was not an exception to causes of the negative impact of family size.

Bags of fertilizer used had a negative relationship with output. Cocoa production and supply are perfectly elastic in respect to the quantity of fertilizer used (COCOBOD). Therefore, ones the cocoa reaches the fruit bearing stage, it does not require so much fertilizer to produce given good climatic conditions.

Number of times insecticides is used was found to be negatively related to output. This is because according to the farmers their main source of financing their household expenditure is the revenue from cocoa sales. Therefore they find it difficult getting funds for the purchase of insecticides.

Some also informed that due to the availability of the mass spraying, they hardly spend their own resources in the purchase of insecticides.

Moreover, production years, farm age, family labour, bag of fertilizer used and number of times insecticides is used was statistically insignificant at an error level of 1%, 5% and 10% respectively.

However, farm size, hired labour, number of time or mass spraying, Total Revenue, male characteristics, no formal education and hybrid seed type were found to have a positive relationship with output level.

Farm size had a positive relationship and by implication larger farm sizes determines larger production. Furthermore, farm size was statistically significant at error levels 1%, 5% and 10% respectively with 239 degrees of freedom. This contradicts results produced by Rao (1981) that smaller farm yield higher than bigger farms experiencing technological change. That is farm need technology, but the extent technology is introduced will also depend on the size of the farm.

Table 4.3 also shows a positive relationship between hired labour and output produced. This implies that when more labour hours are hired on the farm, the production increases. Here, the implication is that hired labour could be more efficient than family labour and it may be due to social loafing on the part of family members. In addition, at error levels of 1%, 5% and 10% the hired labour co-efficient was statistically significant with 239 degrees of freedom.

From Table 4.3, the relationship between total revenue and output is positive and besides was statistically significant at error levels of 1%, 5% and 10% respectively with 239 degrees of

freedom. This suggests farmers are highly motivated by the reward (price) from cocoa and therefore becomes critical for stakeholders to be very critical about the return to farmers in terms of price level.

No formal education according to Table 4.3 could yield 0.91 better than those with formal education in cocoa production in the Ashanti region. At error levels of 1%, 5% and 10% respectively, no formal education was statistically significant.

From Table 4.3, a male farmer would produce output by a margin of 0.2864 more than being a female. However, at error levels of 1%, 5% and 10% respectively, gender (male) was not statistically insignificant with 239 degrees of freedom.

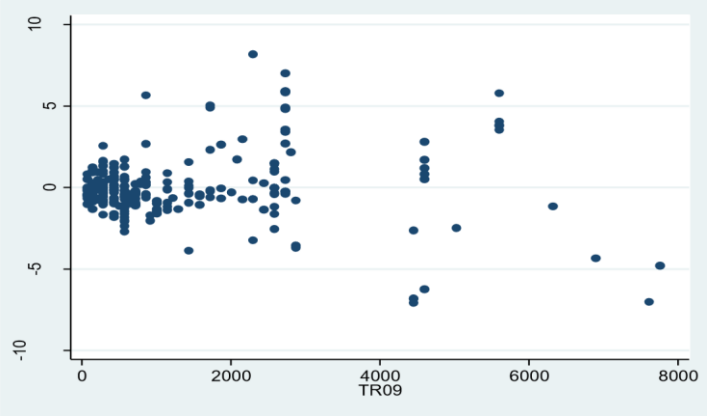
Hybrid cocoa seeds tend to produce 0.35988 better than the traditional seeds. And this implies that production of cocoa would be improved if more hybrid seeds are used for propagation.
However, at error level of 1%, 5% and 10% respectively the co-efficient parameter was found to be insignificant.

It was found that on the overall basis (F- test) the parameter estimate were significant. However, the t- test showed that four independent variables were statistically significant at error levels 1%, 5% and 10% respectively with 239 degrees of freedom.

- **Weighted Least Squares (WLS) Results**

Because the study was a cross sectional study and that cross sectional studies are prone to hetereoscedastic problem, a *Breusch-Pagan Test* was conducted to test for the presence of hetereocedasticity in the OLS regression results. The test indicated the presence of hetereoscedasticity. That is the variance of the error term was not constant for the variouse observations. Consider the *residual-predictor* plot for total revenue which shows a correlation between total revenue and the errors. And this presupposes that Total Revenue was a key variable causing the hetereoscedasticity.

Figure 4.2: Residual versus Total Revenue



{Source :Author's Construction} *TR09 =Total Revenue for the farmer in 2009*

Figure 4.2 shows relationship plot between the residuals and total revenue. And by that total revenue was considered to be causing variations in the variance of the error term with variance inflating factor of 3.03. The spearman correlation between the error term and total revenue also proved higher association between errors and Total Revenue. The regressors and their variance inflating factor (VIF) and ToR are presented in the Table kk* in the appendix. The regression equation was transformed separately with the inverse of Total Revenue $(1/TR09)^4$. The transformation with total revenue is shown below in Table 4.4.

Table 4.4 : WLS results- Transformation With Total Revenue

VARIABLES	Coefficients.	T-statistic	P-value
Production Years	-.0546865	-0.68	0.500
Farm Age, 2010	.0101951	1.39	0.167
Farm Size, 2010	.1048428	6.79	0.000*
Hired Labour, 2010	.0602573	5.36	0.000*
Family Labour, 2010	-.0168727	-0.77	0.443
No. Of Times Insect, 2010	-.0268985	-0.93	0.351
No Of Times Of Mass Spray, 2010	-.0010612	-3.34	0.731
Total Revenue, 2010	.0069075	34.64	0.000*
Male	.135932	1.95	0.052***
No.edu	.1973305	2.43	0.016**
Hybrid Seed	.1869046	2.30	0.023**
Fertiliser Bags, 2010	-.0105216	- 0.76	0.451
Constant	-.2696592	-2.30	0.023

*{Source :Author's Construction} * Statistically Significant at 1% error level *** Statistically Significant at 10% error level ** Statistically Significant at 5% error level*

The transformation as shown from the Table 4.4 maintained the sign of the co-efficient parameters provided by the Ordinary Least Squares (OLS). However, three additional variables co-efficient: number of time of mass spraying, no formal education and hybrid seed type were found to be significant at least 10% error level with 239 degrees of freedom. Co-efficient of determination (R^2) and adjusted co-efficient of determination still remain very appreciable at 91.56% and 91.14% respectively. The F-test still recommend that the independent variable co- efficients are statistically significant.

- **Log- Linear Regression Results**

The log- linear regression provided a co- efficient of determination (R^2) of 97.36% and adjusted co- efficient of determination of 97.2%. This means that at least 97.2% of the behaviour in log of output is explained by the log of the independent variables. The independent variables have fairly inelastic relationship with output. This is presented in Table 4.5.

Table 4.5: The Log- Linear Regression of Output and Non-Dummies

	Coefficients.	T-Statistic	P-value|
Ln Production Years Of Famers	-.0630482	-0.91	0.364
Ln Farmage, 2010	-.0254473	-0.62	0.534
Ln Hired Labour, 2010	.1123988	4.02	0.000*
Ln Fertiliser Bags, 2010	-.0299866	-0.95	0.343
Ln No Of Times Insect, 2010	.0361213	0.81	0.422
Ln No Of Times Mass Spray, 2010	-.1152931	2.19	0.031**
Ln Total Revenue, 2009	.9730697	34.67	0.000*
Ln farmily size	0.094221	0.41	0.001*
Ln family labour	-0.04333	-0. 54	0.221
Constant	-4.623519	-29.31	0.000

*{Source :Author's Construction}*Statistically Significant at 1% error level ** Statistically Significant at 5% error level*

Table 4.5 shows that the co-efficient parameters maintained their signs. Moreover the log transformation added that the results are hetereoscedastic free. At error levels of 1%, 5% and 10% respectively, the null hypothesis is accepted that the variance of the error term remains the same. Note one of the reasons for running the log-linear regression was to enable the estimation of the elasticity.

4.6 Summary Of The Three Regression Results

Table 4.6: Comparison of the Three Regression Results

VARIABLES	OLS	WLS	LOGARITHMIC
Production Years Of Farmer	-.3834845	-.0546865	-.0630482
Farm Age By 2010	-.0230766	.0101951	-.0254473
Farm Size, 2010	.1148967	.1048428	0.094221
Hired Labour, 2010	.0865727*	.0602573*	.1123988*
Family Labour, 2010	-.0755879	-.0168727	-0.04333
Fertiliser Bags, 2010	-.0027504	-.0105216	-.0299866
No Of Times Insecticides , 2010	-.0645701	-.0268985	.0361213
No Times Mass Spraying, 2010	-.0051089	-.0010612	-.1152931
Total Revenue, 2009	.0072237*	.0069075*	.9730697*
Male	.2863586	.135932	N/A
No.edu	.9130537**	.1973305 **	N/A
Hybrid Seed	.3598788	.1869046	N/A
Constant	.27158	-.2696592	-4.623519

{Source :Author's Construction} *N/A = Not Available* **statistically significant at 1% for all.*
***statistically significant at* 5%

From Table 4.6 hired labour and total revenue continued to statistically significant at 1% error level with all the models. No formal education (None) was also significant at 5% error level under OLS and WLS.

- **Conclusion**

Total revenue and hired labour were found to have a serious levels of significance. Meaning with even very small error levels of 1% they were significant. Moreover, Total revenue had the greatest impact on production in terms of co-efficient.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

The chapter deals with summary of findings and base on that, recommendations for policy making are made. Conclusions and Challenges faced by this study are presented herein.

5.1 Summary of Findings

- **Farmers Experience**

Farmers experience as per analysis had negative impact on production. This is unusual relative to theory. In even the lay mans view, they say "*Experience is the best teacher*". Therefore this contradicts theoretical standings that experience would improve once performance. This deviation from theory had several interpretations. Firstly, it could be that the extension services provided for farmers are outdated and therefore the experience they have had no much to current climatic changes. . In fact, the negative impact of experience in production could be explained by Rao (1981) conclusion that smaller farms that experience technological change could yield better than bigger farms.

- **Farm Age**

Rao (1981) and Deolaliker"s result in India has already proved that farm age had a negative impact on production in crop farms. Their study confirmed that ageing farmers are working on ageing farms. This was not different in the case of this study. Farm age had an average of fifteen (15) years. Farmers had responded that, few of the farmers are able to replant new cocoa trees to revamp the production. However, even those who are able to do the replanting fails to achieve higher output because the soil looses it"s fertility (In fact, the negative impact of farm age is due to the fact that the soil loses its fertility over a long period of cultivation) .

- **Farm Size**

The result showed that larger farms had positive impact on production. Though this study deviates from some aspects of Rao (1981), it is practically observable in the Ashanti Region that farmers with bigger farm size are able to produce more given similar climatic condition available to smaller farms as well. Farmers are advice to adopt technology on their farms such as the use of Agro Chemicals in weeding farms.

- **Hired Labour**

It was found that hired labour had positive impact on production. Farmers showed that hired labour are able to work effectively and efficiently especially when given close monitoring and motivation. Hired labour was used in areas of weeding farms and spraying. However, farmers complain that in other crop production it is better to use weedicides and machines like tractors to clear the land before and after planting. Besides, farmers complained the cost of hiring labour is too high for them.

- **Family Labour**

The variable had a negative impact on production. This presupposes that, families are less productive on the cocoa farm. These could be due to two main reasons: One, farmers who were producing on mass scale could not rely heavily on family labour. That is farmers have realized the importance of education and that most of their wards have been sent to school. Secondly, social loafing on the part of family labour as compared to hired labour was identified by farmers as a cause of family labour ineffectiveness. Family members have less commitment than hired labour.

- **Bags of Fertilizer Used**

Fertilizer bags used had negative relationship with production. Farmers explained that the production of cocoa does not depend so much on the quantity of the fertilizer used when the soil quality is very high. Moreover, poor methods of fertilizer application could lead to inverse relationship between cocoa production and quantity of fertilizer applied. Farmers might have applied the fertilizer, however, in a wrong way it can have adverse effect on production.

- **Total Revenue**

The results indicated a positive relationship between revenue and production. That is farmers are motivated by the revenue they generate from production. The producer price per bag of cocoa is fixed or predetermined by the government. This means that farmers revenue can simultaneously be adjusted upward by both increase in price and quantity produce.

- **Education**

It was found that when a farmer had no former education, he is able to produce 0.9131 better than those with former education. No doubt that this contradicts theoretical standings. Those who had no former education were found to spend most of their time on the cocoa farm. Besides those with former education were found to have less hours on the farm. Not only those without former education can produce cocoa better, but those who can spend more productive hours with the farm can produce better.

- **Gender of Farmer**

The regression showed that, being a male produces 0.2864 better than being a female farmer. The reason was that, male farmers who were contacted used both their family members which include their wives on their farms in addition to sufficient hired labour. Female respondents had only themselves to offer as farm labour force since most of them were identified as widows and family members have also departed from them. Therefore, the verdict cannot be dwelled on the fact that cocoa production is gender based but rather resource based.

- **Type of Seed**

The result indicated that hybrid seed is able to yield 0.3599 better than traditional seed. The hybrid type had early maturity period of at most 5 years coupled with high fruit yield than the traditional type. Whiles the traditional type take at least 6 years to mature, the hybrid type take at most 5 years to mature. It must therefore be imperative for government to supply these high yielding seeds for famers.

5.2 Conclusion

Thirteen variables were considered. The Output and Total Revenue (TR) were considered as endogenous variables. The study showed that cocoa production was significantly explained by the independent variables. Different regression specifications were used for different purposes. The log-linear regression was to aid in the estimation of elasticity. OLS produced the best estimates. But WLS estimates were not different from OLS estimates in terms of signs of coefficient. Econometric problem like hetereoscedasticity was present. However, through the help of some econometric tests like Breusch-pagan test, Glejdsers test and log-transformations , the problem was eliminated. In all total revenue stood out as the singular factor that impct greately on production.

5.3 Recommendations

- **Educating Cocoa Farmers On Efficient Application of Fertilizer**.

The study proved that a greater number of the cocoa farmers had no formal education. This according to some extension officers, makes it difficult for farmers to understand and adopt new methods of farming that they carry out for farmers. This is often in the area of fertilizer application which then affects production adversely. Hence, by providing basic education for these farmers on the effective ways of fertilizer application would enhance cocoa production in the Ashanti region.

- **Organization of Retraining Courses for Extension Officers**

It is self evident from this study that Agricultural extension officers are not abreast with current scientific development in cocoa production. This means that, some extension officers still use the archaic methods of farming when they meet farmers. These ideas are practically non-productive. Therefore, if extension officers are given enough retraining programmes then it will help to update them on new scientific developments.

- **Subsidizing Farm Inputs**

It was evident from the study that farmers are not able to purchase some necessary farm inputs due to their price. This goes a long way to affect national output. Hence, when increased subsidy is provided on these farm inputs, then their cost will come down which will enable the average farmer to be able to purchase.

- **Upward Adjustment of Producer Cocoa Price**

It was also, found that cocoa price could seriously affect production through the total revenue. Farmers had a high response to total revenue. This means that , when cocoa price is adjusted upward farmers would be motivated to increase output. This upward adjustment in prices is necessary especially during times of inflation.

- **Improvement in Mass Spraying Exercise**

The mass spraying was observed to have a positive impact on production. It could be seen that farmers received an average of two times per production year. This means that, the mass spraying exercise should not just be perpetuated, but must use modern chemicals to enhance cocoa production.

- **Inclusion of Cocoa Production into The National Youth Employment Programme**

The study proved that most of the farmers were ageing and working on ageing farms. To find substitutes to these aged farmers , the national youth employment programme can lure the youth into the production of cocoa production by providing incentives. This in way will help curb the ascendency of unemployment.

- **For Further Studies**

This study recommends for further studies to be diversified by way of the following: using panel data, expanding the sample size, expanding geographical coverage and adding extra independent variables.

5.4 Challenges of the Study

A couple of limitations could be identified with this study. The first limitation has to do with respondents. Most of them, whom the study came across, were not able to read and write. The researcher had to interpret the questionnaire in the local language, and write the response given by the respondents. In addition the respondents prolonged a simple answer to a question just to impress. These consumed a lot of time allocated for the study.

Moreover, the researcher had to meet a lot of dignitaries including agricultural supervisors, the Assemblymen before permission could be granted to distribute questionnaire to farmers and interviews with officials also granted.

The third limitation is the reluctance of section of the farmers to accept to answer the questions. Most were of the view that their farms were not sprayed because of politics, and therefore were reluctant in answering the questionnaire. In effect it disturbed the smoothness in collecting the data.

Combining different econometric techniques was a problem for this study. The study had use different statistical packages in order to complete the analysis. This was necessitated because of the econometric problems like hetereoscedasticity, that was present.

Lastly, resource constraint was a major problem in terms of travelling and lodging expenses to administer questionnaires in the study areas which was very far from the researcher‟s place of residents. Coupled with that, the study areas were in three different districts. This to a large

extent affected the sample size that was intended for the research. The geographical coverage was very large per this study. Therefore , it was difficult raising funds to pay for cost of printing and collection of data and analysis of data.

5. 5 Contribution to Knowledge

The study extended the independent variables to twelve. It is therefore important to include many relevant independent variables to ensure a higher R^2. The study also disintegrated labour used into hired labour and family labour. This helped to measure the impact of the different source of labour. Moreover, the study has adopted different modelling techniques (OLS and WLS) and estimation of both linear and non-linear production functions.

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APPENDIX

Table A: COCOA PURCHASES IN GHANA 1970-2004 (METRIC TONNES) BY REGIONS

Year 1970-2004	Total production	Ashanti Region	B/A Region	Central Region	Eastern Region	Volta Region	Western Region
1969/70	417,457	125,406	115,393	55,236	69,431	20,878	31,113
1970/71	427,894	130,544	112,037	59,713	73,865	15,340	36,395
1971/72	469,864	145,557	119,156	57,968	86,000	10,289	50,894
1972/73	421,843	125,648	112,754	43,497	74,627	22,188	43,129
1973/74	354,634	107,028	78,502	47,886	65,622	14,489	41,344

1974/75	378,759	109,802	81,526	50,766	73,393	14,009	31,787
1975/76	400,321	124,315	88,415	49,726	68,588	13,622	55,655
1976/77	324,111	104,215	78,326	38,547	53,452	9,228	40,343
1977/78	271,339	89,619	69,541	21,553	41,290	7,368	41,968
1978/79	265,076	86,913	50,408	25,702	50,200	5,980	45,873
1979/80	296,419	100,362	74,893	19,032	45,051	4,776	52,305
1980/81	257,974	91,537	47,598	25,563	46,632	1,496	45,148
1981/82	224,882	70,790	49,747	22,069	36,890	1,683	43,703
1982/83	178,626	55,310	35,173	17,604	31,254	3,776	35,509
1983/84	158,956	47,095	29,657	13,782	25,523	2,656	40,243
1984/85	174,809	44,928	28,756	19,070	28,540	1,028	52,487
1985/86	219,044	54,468	36,476	27,636	34,614	1,117	64,733
1986/87	227,765	56,870	32,644	26,912	33,399	1,903	76,037
1987/88	188,177	49,766	28,796	19,116	29,951	1,806	58,742
1988/89	300,101	76,268	48,647	28,423	39,193	1,676	105,894
1989/90	296,051	72,124	45,125	31,208	33,296	1,785	111,513
1990/91	293,352	60,958	42,016	26,517	32,261	2,645	128,955
1991/92	242,817	52,467	33,734	19,356	26,196	1,595	109,469
1992/93	312,123	65,355	37,016	29,587	34,619	2,272	143,274
1993/94	254,653	47,172	30,927	21,936	25,372	923	128,323
1994/95	309,452	64,025	37,014	20,518	33,667	1,067	153,161
1995/96	403,872	81,983	39,051	36,413	38,935	906	206,585
1996/97	322,488	64,534	34,195	22,415	34,305	1,678	165,361
1997/98	409,383	78,913	39,900	29,470	43,156	976	216,967
1998/99	397,675	74,448	40,244	29,676	40,535	2,062	210,710
1999/00	436,947	82,068	39,310	31,360	41,526	2,352	240,331
2000/01	398,771	72,994	33,109	32,136	46,225	1,680	203,627
2001/02	340,562	57,011	31,432	30,039	39,343	1,079	181,658
2002/03	496,846	82,445	45,309	39,989	51,604	913	276,586
2003/04	736,975	121,233	69,688	56,631	67,804	1,909	419,710

Source: Policy Planning Monitoring and Research Dept., COCOBOD (2004)

Table B : The Regressors and Their Variance Inflating Factor (VIF) and ToR

VARIABLE	VIF	1/VIF
Total Revenue, 2009	3.03	0.329664
Farm Size, 2010	2.83	0.353582
Production Years Of Farmer	2.46	0.407169
Farm Age, 2010	2.16	0.462058

Fertiliser Bags, 2010	2.08	0.480554
Hired Labour, 2010	1.89	0.530359
Hybrid Seed	1.57	0.635031
No Of Times Insect10	1.31	0.760730
Family Labour, 2010	1.26	0.791523
No Times Of Mass Spray, 2010	1.19	0.840414
None	1.12	0.893262
Male		.945032

{Source :Author's Construction}

1.06

QUESTIONNAIRES FOR FARMERS

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECNOLOGY (K.N.U.S.T.), KUMASI,

DEPARTMENT OF ECONOMICS

EFFAH ERIC SARKODIE (M.Phil. ECONOMICS)

This survey seeks to find out the determinants of cocoa production in the Ashanti region. Therefore, I should be much grateful if you could complete the form below. You are assured of greater anonymity regarding the responses you will provide. The information provided will enable me complete my ***M.PHIL*** thesis.

Instruction: *please* ***TICK*** *or provide* ***SHORT ANSWERS*** *where appropriate.*

1. Sex

Male	1	
Female	0	

2. Age (in years)

below 25	1	
25-30	2	
31-40	3	
41-60	4	
above 60	5	

3. Marital status

Single	1	
Married	2	
Divorced	3	
widow/widower	4	

4. How many of your family members work on your farm including yourself ?
……..

5. What is your education background ?

No formal education	0	
Formal education	1	

6. How long have you been in the production of cocoa?

below 10 yrs	1	
10-20	2	
21^{+}	3	

7. Have you heard of the mass spraying?

Yes	1	
No	2	

8. If (7) is yes, when did you start benefiting from the mass spraying?

Since 2001	1	
After 2001 (specify……)	2	

9. If (7) is yes, how many times was your farm sprayed in 2010 ?
   .....

10. Do you grow other crops on the land on which you cultivate your cocoa?

Yes	1	
No	2	

11. How old was your farm in 2010 ? .....

12. Which type of seed do you use?

Traditional	1	
Hybrid	2	
Both traditional and hybrid	3	

13. What was the size of your farm in 2010 ? (measured in acres) ……..

14. Please provide numerical values in the table below. (*i.e. 1,2,3,4,…..*)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Farm size										
Hired Labour										
Family Labour										
Bags of fertilizer										
No of times insecticides is used in a year										
No of times of mass spraying										
Output in bags										

Please indicate your locality……

Thank you