# KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI, GHANA.

## "ASSESSING THE FINANCIAL VIABILITY OF THE COCOA "HI-TECH" AND THE "CODAPEC" PROGRAMMES IN GHANA"

**BY**

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**MASTERS OF SCIENCE IN AGRICULTURAL ECONOMICS**

**JUNE 2012**

## CERTIFICATION

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

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## ABSTRACT

Cocoa production in Ghana has been declining over the years due to declining soil fertility and incidence of diseases and pests, among other factors. To address these challenges the Government of Ghana in collaboration with Cocoa Research institute of Ghana (CRIG) implemented the "CODAPEC" and "HI-TECH" programmes in 2001. The overall objective of the study was to assess the financial viability of these programmes. Primary data was collected from a simple random sample of 259 cocoa farmers in three cocoa districts in Ghana through personal interviews with the use of semi-structured questionnaires. Descriptive statistics were used to summarize the characteristics of the farmers and the parameters of interest in the study. For the inferential analysis; partial budget and financial viability tests including profitability index, investment appraisal techniques and sensitivity analysis were conducted. The study showed that the introduction of "CODAPEC" and "HI-TECH" programme in the Cocoa industry have increased output to levels above the national average of 0.35mt/ha to 0.68mt/ha and 1.68mt/ha respectively. The study also estimated returns on investment ratio of 1.29 and 2.05 for "CODAPEC" and "HI-TECH" farmers respectively. The estimated Tisdell's Total Factor Productivity indices over the years showed that the "HI-TECH" programme exhibited high level of profitability than the "CODAPEC" which only sees to the control of diseases and pests. Results from the investment appraisal technique and sensitivity analysis showed that the two projects were both viable and profitable. However, the "HI-TECH" programme which combines fertilizer application to diseases and pests control in addition to the adoption of good agricultural practices was more viable and profitable than the "CODAPEC" programme which only tackles diseases and pests problems in coca production. The study therefore recommended that stakeholders and policy makers should continue to invest in both "HI-TECH" and "CODAPEC" programmes since they complement each other to boost cocoa production.

## DEDICATION

This thesis is dedicated to my dear late parents; the late Opanin Kwasi Owusu-Akyeaw and the late Madam Abena Kyeiwaah. Mum and Dad, this is in recognition and appreciation to your contributions to my educational and social life.

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| | |
|---|---|
| ADB | Asian Development Bank |
| AfDB | The African Development Bank |
| AEA | Agricultural Extension Agent |
| AgSAP | Agricultural Sector Adjustment Programme |
| CF | Cash flow |
| CIF/cif | Cost, Insurance and Freight |
| CMC | Cocoa Marketing Company |
| COCOBOD | Ghana Cocoa Board |
| CODAPEC | Cocoa Diseases and Pests Control |
| CRIG | Cocoa Research Institute of Ghana |
| CRP | Cocoa Rehabilitation Programme |
| CSSVD | Cocoa Swollen Shoot Virus Diseases |
| DADU | District Agricultural Development Unit |
| IRR | Internal Rate of Returns |
| NPV | Net Present Value |
| FOB/fob | Free-on-Board |
| GAP | Good Agricultural Practices |
| GDP | Gross Domestic product |
| HI-TECH | Cocoa High Technology |
| ICCO | International Cocoa Organization |
| ISSER | Institute of Statistical Social and Economic Research |
| LBC | Licensed Buying Company |
| MOFA | Ministry of Food and Agriculture |
| MTDP | Medium Term Development Programme |
| NPV | Net Present Value |
| OA | Operational Area |
| OCC | Opportunity Cost of Capital |
| PBC | Produce Buying Company |
| PPRC | Produce Price Review Committee |
| ROI | Returns on Investment |
| SIF | Social Investment Fund |
| TFP | Total Factor Productivity |
| THLD | Twifo Hemang Lower Denkyira District |
| TOPP | Twifo Oil Palm Plantation |
| UNCTAD | United Nations Conference on Trade and Development |
| WVI | World Vision International |

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# CHAPTER ONE

# INTRODUCTION

## 1.1 Background

Cocoa is a cash crop grown throughout the humid tropics with about 6.5 million hectares planted in 57 countries. Although cocoa has been cultivated for centuries in Central America, it is relatively newcomer to Africa, and even more so in Asia. In 2009, world production reached 3.5 million tonnes of cocoa beans. Africa holds a dominant position with almost 80% of production volumes, 30% coming from the Ivory Coast. Ghana (20%) and Nigeria (7%) are two other important producers. The average yield is conventionally considered to be around 400kg of beans per hectare per year, but yields could range from 100 to 3,000 kg per hectare per year(ICCO,2010 and E-gfar research partnerships, 2005).Approximately 90% of the productions are exported in the form of beans or semi-manufactured cocoa products. Three countries export large volumes of cocoa beans or products: Ivory Coast (over 1.5 million tons), Ghana (1.025million tons) and Indonesia (over 0.4 million tons). The major importers of cocoa and cocoa products are Europe (over 2 million tons) and the USA (over 1.0 million tons) (UNCTAD, 2009 and ICCO, 2010).

Cocoa is grown principally in West Africa, Central and South America and Asia. In order of annual production size, the eight largest cocoa-producing countries at present are Ivory Coast, Ghana, Indonesia, Nigeria, Brazil, Cameroon, Ecuador ua New Guinea. These countries represent 90% of world production(ICCO, 2010; UNCTAD, 2009; Dizolele, 2005).In the early 1970s production was concentrated in Ghana, Nigeria, Ivory Coastand Brazil, but it has now expanded to areas such as the Pacific region, where countries like Indonesia and Malaysia have shown spectacular growth rates in production.

Cocoa whose original abode is the tropical forest of the Amazon basin in Central America, has since its discovery as a food item, moved from the Central America to Africa. Cocoa was introduced into the Ghanaian agriculture in the last quarter of the 19th century from Fernando Po by TettehQuarshie a Ghanaian national. It soon assumed the role of the leading export crop and foreign exchange earner for the country (Amoah, 1995).

Ghana is basically an agricultural country with about 60% of its population engaged in agriculture. Cocoa is its major cash crop and the 2005/06 season saw close to 741,000 metric tonnes of premium quality cocoa beans produced.This is the highest production in the history of cocoa industry since cocoa production became a commercial activity in Ghana more than 100 years ago. The second highest output of 736,699 metrictonnes was recorded during the 2003/04 cocoa season (Sarpong, 2005and ICCO, 2006).This volume of cocoa beans fetched a CIF value of US$1,214,328,469 or an FOB value of US$1,166,055.00. This is the highest export revenue ever achieved by the cocoa sub-sector of the Ghanaian economy. The closest to this record achievement was FOB value US$889,711,486 in 2002/03 cocoa season. The normal export receipts for most years have ranged between US$300 million and US$400 million (ICCO, 2006).



## 1.2 Problem Statement

Ghana, the second largest cocoa producing country in the world after Ivory Coast, was until recently, the World's leading exporter of cocoa and continues to be a major exporter of the produce. Cocoa is cultivated in six out of the ten regions in Ghana by small-scale peasant farmers.There are support services provided by the Ministry of Food and Agriculture in the form of extension services and research activities to ensure sustainability of qualityyields.In spite of the significant gains made by other sectors of the economy in recent times, cocoa still continue to occupy a key position in Ghana's economy, in terms of foreign exchange generation and domestic income as well as being a major source of revenue for the provision of socio-economic infrastructure in the country. The industry also employs about 70% of the national agriculture labour force in the country (ISSER, 2006).

By 1930 after Ghana had been the leading producer for twenty years, pests and disease problems plagued cocoa production in the Eastern Region and production fell drastically. In 1935, Sir Stockdale recommended the setting up of a Research station at Tafo to investigate production problems of pests and diseases in order to maintain production levels. The control of capsids was initially successful but proved in the long term to be as intractable as the cocoa swollen shoot virus disease.In 1956 a large-scale capsid control programme, funded by the Cocoa Marketing Board was embarked upon by the Ministry of Food and Agriculture. The 1964/65-season production figure of 580,000 metric tonnes was attributed to this spraying programme. However, after this exercise farmers failed to continue to spray their farms regularly to sustain the level of control achieved (Amoah, 1995).The cocoa Rehabilitation

Programme I and II (CRP I and II) also failed to arrest the decline in Ghana's cocoa production and this was also attributed to the low producer price paid to farmers, which resulted in the neglect and abandonment of farms.CRP III of 1988 - 1996 aimed at addressing producer price with a policy to increase the producer price annually to 65% of the world market price also produced an initial result by raising production to 300,000 metric tonnes in 1988/89 cocoa season due to the rehabilitation and maintenance of abandoned and neglected farms by farmers (Amoah, 1998).

A critical analysis of these programmes revealed that, most of the programmes did not sufficiently tackle the root cause of the problems affecting cocoa production and the needs of the farmers to increase production levels on a sustainable basis.A study conducted by the Ghana Cocoa Board Task Force in1994 indicated that about 49.3%of farmers interviewed produced less than 256kg/ha in 1991/1992 season and 23 % produced between 256kg and 384kg/ha. However, as many as 64%of farmers produced less than 256kg/ha(Ghana Cocoa Board, 1994).

The country's cocoa industry has had its production fluctuations. Ghana's cocoa production stood at 580,000 metric tonnes in 1965, but by 1983, it had dropped to as low as 150,000 tonnes. Low prices and poorly motivated cocoa farmers switched over to competing crops, further aggravating the problems of inefficiency and under-investment.The problem of declining cocoa incomes over the past years can be attributed to low yield per unit area (productivity); and this compelled farmers to look for areas where virgin lands or forests abound since virgin forest supports cocoa production, even though some of the soils are not potentially suitable for cocoa cultivation (Appiah *et al*., 2000).

Appiah*et al*., (2000), emphasized that the peasant cocoa industry in Ghana had been based on the exploitation of the fertility built by the forest and that for cocoa established from virgin forest on fertile soils, fertilizer may not be required for many years. Farmers are not making any conscious effort of maintaining soil fertility by the application of organic or inorganic nutrients to the soils cropped with cocoa and therefore soils not suitable for cocoa cultivation are being encroached and this has led to decline in land meant for food and other crops.One important factor, which has been overlooked, is the relationship between soil fertility and cocoa production. The removal of essential nutrients, through harvesting over long periods without replenishment, could be one of the major causes of decline in the productivity of

cocoa farms. The low productivity which is the contributing factor to low levels of farmers' incomes has resulted frompoor agronomic practices and poor farm maintenance culture on the part of the cocoa farmers.

Appiah (2005) reported that as a result of intensive research at Cocoa Research Institute of Ghana (CRIG), government initiated two programmes, which have made positive impact on the cocoa sector within the last three years. This upward trend is expected to continue into the future as a result of such policy measures as the Cocoa Disease and Pest Control (CODAPEC) and the Cocoa High Technology (Cocoa HI-TECH) programmes, which aimed at increasing yields by application of technologies developed by the Institute. Sustainable cocoa industry can only be maintained if the problems presently associated with production such as low yield obtained by the farmer, degradation of the environment, low soil fertility and low incomes of farmers and poor agronomic practices such as disease and pest control are addressed. A sustainable project should not result in exhaustion of the resources and therefore should also preserve the natural environment to ensure continuity of the production process in the future. In an attempt to address these problems, the government introduced the Cocoa "HI-TECH" and the Cocoa Diseases and Pests Control programme in 2001. However, since the inception of the programmes, financial analyses have not been carried out to ascertain their viability andprofitability. The various costs and returns associated with these programmes ought to be examined in order to ascertain their viability from a private farmer's perspective.

The removal of subsidy from agro-inputs in 1984 as a government policy has put the agro-industries in the hands of the private entrepreneur and this has contributed to agro-inputs becoming quite expensive on the local market, making them non-affordable to the poor cocoa farmer.In the light of this effect of market liberalization, will it be viable for the private cocoa farmer to continue the policy? The purpose of the study was to appraise the two programmes to ascertain their profitability and viability from the view point of the private cocoa farmer.

### 1.3 Research Questions

The study seeks to answer the following questions:

Have the "CODAPEC" and "HI-TECH" programmes contributed to improved output per unit area in cocoa production?

What are the costs and revenues (GH¢/ha) associated with the operational activities in the "CODAPEC" and "HI-TECH" programmes?

Are the "CODAPEC" and the "HI-TECH" programmes financially viable?

## 1.4 Objectives of the Study

The main objective was to evaluate the financial viabilityand profitabilityof the cocoa "HI-TECH" and "CODAPEC" programmes.

The specific objectives were as follows:

1. To examine the effects of "HI-TECH" and "CODAPEC" programmes on cocoa productivity in Ghana.
2. To determine the costs of the operational activities associated with the cocoa "HI-TECH" and "CODAPEC" programmes.
3. To estimate the returns from cocoa production under the "HI-TECH" and "CODAPEC" programmes.
4. To assess the financial profitability of the cocoa "HI-TECH" and "CODAPEC" programmesin Ghana.

## 1.5Justification of the Study

Cocoa is one of the most important cash crops and the life-wire of the Ghanaian economy; the farmer sees it as an important tropical crop, which generates his much-needed income for the upkeep of his family and himself, and at the same time, helps him raise his standard of living. Therefore, manufacturers, consumers, researchers and academicians are much concerned to ensure its continuous existence and better performance, as cocoa is a fascinating tree crop with numerous challenges and opportunities for different categories of beneficiaries or experts.

Several attempts in the mid-1940s, to compulsory cut off diseased cocoa trees and replant them were objected to by farmers for not understanding why it was necessary to remove the trees which still produce some crops. The Cocoa Rehabilitation Programmes I, II and III all started well but later failed to achieve the required impact after withdrawal of government subsidies. Careful evaluation of these programmes and most cocoa maintenance programmes as well as the mass spraying programme sponsored by the government of the first Republic and other successive governments also revealed that they were highly successful whilst in operation but failed to institute the needed training for farmers to carry on the control or maintenance programmes on their own. In the light of the forgoing, it is very imperative to examine the viability of the new programmers ("HI-TECH" and "CODAPEC") from the private farmer's perspective. This is because when government decides to withdraw its

support, individual farmers are expected to continue the programme to ensure that cocoa production increases on a more sustainable basis. The current study will provide evidence on the financial viability andprofitability of these two programmes to enable all stakeholders in the cocoa industry (especially Government)to take the necessary steps to ensure the long term sustainability of these programmes after the withdrawal of government support.

## 1.6 Organisation of the Study

The study is organized into five chapters. Chapter one introduces the study by discussing the background and the problem statement. Chapter two reviews the relevant literature. In particular the origin ofGhana's cocoa production, the "HI-TECH" and "CODAPEC" programmes, agronomic practices in cocoa production and cocoa marketing in Ghana are discussed. Chapter threediscusses the methodology employed in the study. The type and data sources including data collection techniques and financial tools for investment appraisal have been discussed. Chapter five provides conclusions, recommendations as well as suggestions for future research.

# CHAPTER TWO

# LITERATURE REVIEW

The chapter provides a review of the relevant literature to the study. It discussesthe origin and history of Ghana's cocoa industry and socio-economic importance of Ghanaian cocoa industry. Cultural practices in cocoa production, disease and pest control, fertilizer use and cocoa marketing and pricing in Ghana have been highlighted.The "CODAPEC" and the "HI-TECH" programmes have been discussed in detail.

## 2.1 Origin of Cocoa Production in Ghana

The origin of cocoa takes us back to the mysterious Olmecs and Mayas. These highly cultivated Central-American civilizations gave us the cocoa tree. They believed cacao to have originated from a divine source and legend states that the good and wise god *Tula Quetzalcoatl* brought with him its seeds that he cultivated in his garden, thus bringing the tree to earth (Motamayor et al, 2002). The cultivation of *Theobromacacao* soon spread throughout the world. As the demand for cocoa increased in Europe in the nineteenth and twentieth centuries, cocoa became a pan-tropical crop. Firstly, cocoa spread to Trinidad and other islands in the Caribbean from where it was taken further to the Philippines and the East Indies, and then to Sri Lanka, Brazil and West Africa (UNCTAD, 2000 and Young, 1994).

Acquaah (1999) noted that cocoa has been a commodity in the world trade for nearly 400 years. The first exports were from Mexico to Spain. Soon Venezuela became the principal exporter and apparently held the position for over 100 years. Ecuador became the principal exporter around 1830 and held the position for some 60 years, Brazil took over from Ecuador but 20 years later, the leading position was taken over by Gold Coast (now Ghana), the principal exporter in 1911 and held this position for 66 years, only ceding it to Ivory Coast in the late 1970s. Acquaah further indicated that the plant has been in existence for 4,000 years and thus the early history of cocoa, its discovery and distribution from one part of the tropical world to another, is probably the most interesting and romantic that any crop can boast of.

From annual production of less than 125,000 tonnes in the early twentieth century, annual global output rose to reach a record of 3.1 million tonnes and 3.45 million tonnes in the 1999/2000 and 2003/04 cocoa seasons respectively with an annual average growth rate of 3.5%. Despite the large number of producing countries, production is extremely concentrated in few countries. In 1999/2000, 70% of output was produced by just three countries: - Ivory

Coast, Ghana and Indonesia. The success of these countries in producing cocoa lies in their low costs of production, the comparative advantage of cocoa over competing crops within these countries, and the relative success in limiting the incidence of disease. Outside these three countries, Nigeria, Brazil, Cameroon, Malaysia and Ecuador are the other substantial producers, accounting for slightly more than 20% of output, with the remaining forty or so countries producing just 10% (Gray, 2000). According to Earth Satellite Corporation's Cast Service, 2003-04 world production totaled 3.45million metric tonnes; Ivory Coast the world's leading producer contributed 1.39 million metric tonnes forming 39.3% whilst Ghana the second highest producer also contributed 734,000 metric tonnes representing 21.3% of the global output (Ganes-Chase, 2004; ICCO, 2005; UNCTAD, 2005;Dizolele, 2005)



Table 2.1 shows the world's cocoa production from 1960 to 2006 and the placement of the four highest producing nations.

**Table 2.1 PercentageSharesof the Worlds' LeadingCocoa Producers**

| Country/Region | 1960-69/70 | 1970-79/80 | 1980-89/90 | 1990-99/00 | 2000-05/06 |
|---|---|---|---|---|---|
| World's | 1,263,900 | 1,497,538 | 2,025,780 | 2,652,580 | 3,234,750 |
| Ivory Coast | 11.7 | 16.7 | 28.9 | 37.9 | 40.75 |
| Ghana | 33.42 | 23.51 | 11.16 | 13.5 | 17.97 |
| Indonesia | - | 0.3 | 2.5 | 10.6 | 13.48 |
| Brazil | 12.5 | 15.8 | 18.0 | 9.0 | 4.88 |

Source: ICCO's Statistical Bulletins and Ghana COCOBOD, 2006.

## 2.2 The History of Ghana's Cocoa Industry

In 1815, the Dutch missionaries planted cocoa in the coastal areas of Ghana, whilst in 1857; the Basel missionaries also planted cocoa at Aburi in Ghana. These did not result in the spread of cocoa cultivation until Tetteh Quashie a Ghanaian and native of Osu in Accra and a blacksmith, returned from Fernando Po in 1879 with Amelanado cocoa pods and established a farm at Mampong-Akuapim. Farmers bought pods at £ 1 per pod from his farm to plant and cultivation spread from the Akuapim area to other parts of Eastern Region and finally to the rest of the country and this marked the beginning of commercial growing of cocoa in Ghana (Amoah, 1995).

The first documented shipment of cocoa beans from Ghana involved two (2) bags to Hamburg in January 1893, together with 18 bags of coffee. Two (2) bags had already been sent to Hamburg in 1891 but apparently were not recorded (Historical Perspective, 2004). The volume grew rapidly to 20,000 metric tonnes in 1908, and by 1911 Ghana was the World's leading producer with 41,000 metric tonnes. In the early 1920s, Ghana contributed about 40% of the world output (Historical Perspective, 2004). Production reached 400,000 metric tonnes in 1960 and held for about decade, increasing to a record of 580,869 metric tonnes in 1964/65 before falling sharply to 324,000 metric tonnes in 1976/77 and steadily thereafter to a 62 year low of 158,530 metric tonnes in 1983/84 season as a result of severe drought, bushfires, poor management, diseases, pests and ageing farmers working on ageing farms. Ivory Coast took over the leading position in the 1984 and is still the world's leading producer (ICCO, 2006).

Total production in 2000/01 was 436,000 metric tonnes, 9.8% higher than the output of 1999/2000 season and the highest in the decade (ICCO and COCOBOD, 2006). Ghana cocoa output rose again to 736,700 metric tonnesin2003/04 and hit an unprecedented record level of over 741,000 metric tonnes in 2005/06 season, thus breaking her previous 1965 record of 580,869metriictonnes to maintain her new position as the world's second largest producer of the commodity after Ivory Coast (COCOBOD, 2006). Figure 1.1 below shows the trend of Ghana's cocoa output and producer price from 1960/61 to 2005/06 production seasons.

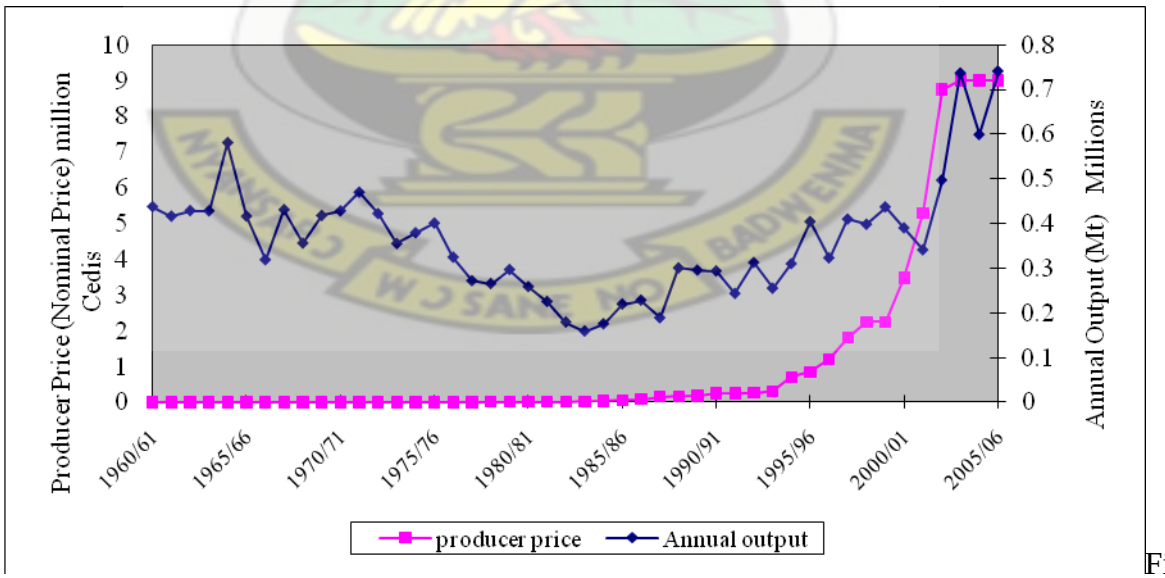


Figure 2.1 Trend in Cocoa Production and Producer Price (Nominal Price) - 1960-2006

Source: COCOBOD, Statistical Services, Accra and ICCO Statistics.

Amoah (1998) indicated that, in the early 1980s as part of the government Economic Recovery Programme (ERP) measures were put in place to restructure the cocoa industry in an attempt to arrest its declining production trend at the time. The cocoa sector reforms, which were implemented through the Cocoa Rehabilitation Programme (CRP) and the Agricultural Sector Adjustment Programme (AgSAP), resulted in several major policy changes but failed to raise the production level as can be inferred from Figure 2.2 below

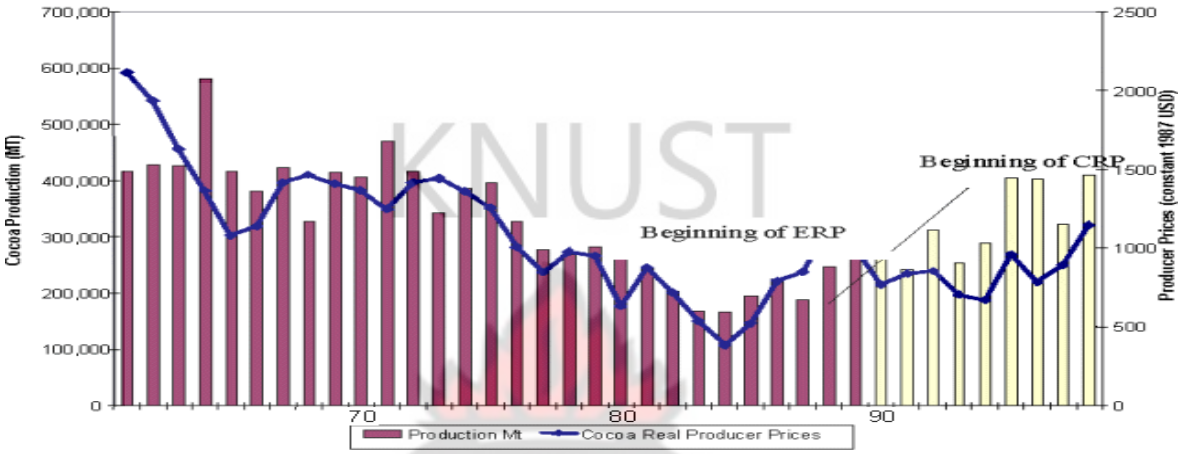


Figure 2.2 Ghana's Cocoa Production (Mt) And Producer Prices (constant 1987 USD)

Note: The bars show the period covered in the first part of the project. ERP denotes Economic Recovery Programme and CRP denotes Cocoa Rehabilitation Programme.

Source: Faostat database and Ghana Cocoa Board.

Cocoa Research Institute at Tafo in Ghana in an attempt to find a lasting solution to the decline in cocoa production in the nation, found out that apart from the neglect of farms by farmers and government, poor maintenance culture; diseases and insect attack, depletion of soil nutrients were some of the major causesof the low production in the country (Annon, 1999; Acquaah, 1999; Abekoe *et al*., 2002). Research has further shown that after 30 years of cocoa establishment yields begun to decline because the tree is a heavy feeder on soil nutrientswhich need to be replaced (Appiah *et al.,* 1997; Opoku *et al.,* 2004). Appiah *et al.,* (2000) indicated that each year, owing to the removal of pods and beans, the soils cropped to cocoa lose some essential nutrients. This loss is estimated from an average annual marketable harvest of 400,000mt dry cocoa beans (plus testa) to be 16,000mt N, P and K, which are not returned to the soil.

Appiah *et al*. (1997) reported that the decline in yield of cocoa of about 17 years old was partly attributable to selection of bad sites and lack of fertilizers use .Appiah *et al.,* (2000)

identified low soil fertility as a major cause of decline in yield of cocoa on peasant farms in Ghana after the evaluation of fertilizer application on some peasant cocoa farms. Table 2.2 below shows some data on cocoa bean production and estimated land area planted with cocoa trees for 2001/02 in Ivory Coast, Ghana and Nigeria. A rough estimate of the yield per hectare is calculated in support of the above statement.

Table 2.2 Distribution of YieldPer Hectare in 2001/2002 Cropping Season

| **Production Statistics** | **Ivory Coast** | **Ghana** | **Nigeria** |
|---|---|---|---|
| **Production** | 1,265,000 | 340,600 | 170,000 |
| **Land area (Hectare)** | 2,350,000 | 1,212,000 | 607,000 |
| **Yield per hectare(mt/ha)** | 0.54 | 0.28 | 0.28 |

Source: Trends in global supply and demand for cocoa. ICCO, 2003.

### 2.3 Socio-economic Importance of the Cocoa Industry in Ghana

The importance of the cocoa industry to the economy of Ghana cannot be over emphasised. Cocoa has since 1911 beenthe backbone of the Ghanaian economy; the crop has made significant strides and major socio-economic contributions to date in areas such as employment, foreign exchange earnings, government revenue and Gross Domestic Product (GDP).Although commercial activities and manufacturing have shown drastic change for the past decades, about half of the total labour force in Ghana still draws its sustenance from the cocoa industry (Acquaah, 1999 and ISSER, 2004). COCOBOD (1998) indicated that the cocoa sector in Ghana employs over 800,000 smallholder farm families for whom cocoa contributes about 70-100 percent of their annual household incomes.The report furthernotedthat the cocoa industry alone employs about 25% of the total labour force in the country. Appiah (2000) emphasized, “Cocoa provides domestic incomes as well as being a major source of revenue for the provision of infrastructure and employs about 60% of the national agricultural labour force in the economy”. The cocoa sector contributes greatly to foreign exchange earnings through export of cocoa beans. Ghana produced as much as 40% of the World’s production and this accounted for 80% of the country’s foreign exchange earnings. By the turn of 1950 cocoa was earning some 70% of Ghana’s foreign exchange and since then cocoa has provided on the average about 60% of Ghana’s foreign exchange earnings (Amoah, 1998 and 2000 ,COCOBOD, 2000).

Cocoa has traditionally contributed to the economy as a major source of export earnings and investment fund in Ghana. Earnings from cocoa export in real terms rose to a peak of

$495million in 1987 from $426 million in 1986 and then started declining. The dominance of this sector continued to decline as Ghana expanded its export base. Cocoa's share of export earnings steadily fell from 67% in 1966 to 26% in 1994 though it appears to have picked up to 35% in 1996 (Aryeetey and Fosu, 2005). In 2003 and 2004 cocoa accounted for 31.9% and 38.5% respectively. Cocoa displaced minerals as a major export in 2004 to break the long standing place enjoyed by mineral as Ghana's top foreign exchange earner from the late 70's to 2003 (ISSER, 2004). Government revenue from international trade transaction is derived basically from two sources, the import related taxes and export duties on cocoa. Manu (1973) indicated that export duty on cocoa accounts for one quarter (1/4) to almost one third (1/3) of total government revenue. Total tax from international trade amounted to ¢3,808.9 billion in 2004 (ISSER, 2004).Approximately two million (2 million) hectares of land representing 50% to 60% of the cultivated land area in the cocoa growing regions is under cocoa production. In addition cocoa's contribution to GDP is of vital importance to the country. In 2003/04 when cocoa output reached its highest level of 736.911 tonnes, the sector contributed nearly 18% to the total GDP in 2004 (ISSER, 2004).

Cocoa which is mostly used in the production of chocolates, beverages and confectioneries, has medicinal value (Appiah, 2004). Ghana's cocoa described by many as the Golden Pod has also been considered by herbal practitioners as a tree of life, theyclaimed that most of the tropical diseases in the sub-region and beyond could be treated with almost every plant growing on cocoa plant (mistletoe) and the cocoa plant itself. In Ghana, apart from the foreign exchange derived from the marketing of cocoa, other products like soft soap ('Alatasamina'), cocoa butter soap, cocoa body cream and animal feed are produced from the discarded pods and placenta after pod breaking operations, while cocoa jam, marmalade, cocoa wine and other cocoa hard and soft drinks are also produced from the sweating(Appiah, 2004). Thus as a single productive sector utilizing much labour and land and providing a lot of employment,foreign exchange and infrastructure, the cocoa industry is of great importance to the Ghanaian economy.

### 2.4 The Cocoa "HI-TECH" and "CODAPEC" Programmes in Ghana

The Higher Technology ("**HI-TECH**") and the Cocoa Diseases and Pests Control ("**CODAPEC**") were programmes initiated in 2001 by the Cocoa Research Institute of Ghana (CRIG) to arrest the decline in Ghana's cocoa production by increasing the productivity of existing stands of cocoa without increasing the total land area under cultivation(Appiah,

2004). The programmes jointly managed by CRIG, COCOBOD and MoFAaimed at overcoming the decline in Ghana's cocoa output by addressing the problem of pests and diseases control, other poor agronomic practices; neglect of cocoa farms; lack of maintenance culture and declining soil fertility.

*The "HI-TECH" Programme*

In line with the objectives of the Cocoa Board's sector development strategy projecting the country's cocoa production to 700,000metric tonnes by 2010, and in an attempt to alleviate poverty among cocoa farmers, the Government of Ghana through the Cocoa Board introduced the Cocoa"HI-TECH" programme.Appiah(2004) defined the "high technology" of cocoa production as sustainable cocoa production by which the farmer increases and maintains productivity, through soil fertility maintenance at levels that are economically viable, ecologically sound and culturally acceptable using efficient management resources. The "HI-TECH" programme is of two components:

i) First is the maintenance of the cocoa farm (agronomic practices), which include weeding twice, or thrice in a year; general pruning, pruning of mistletoes and choppons;
ii) Second is fertilizerapplication of three (3) bags (150kgs) of Asasewura or Coco feed to0.4ha of cocoa farm.Sidalco, a foliar fertilizer, is also used.

AsasewuraandCocofeed are applied at the rate of 300-400 grams per tree per year in ring application at a distance of 70-100 cm from the cocoa tree trunk. The period of application is between the months of April – May for single application or August to September for split application; in either case, application should be at the beginning of the raining season.

*The "CODAPEC" Programme*

The cocoa disease and pest control programme is a national pest and diseasecontrolprogramme initiated in 2001 by the Government of Ghana to address the decline in cocoa production. The programme also aims at assisting farmers to maintain production levels and generate the needed foreign exchange for the development of Ghana. The "CODAPEC"programme is made up of two components:

i) First, the maintenance of cocoa farms which includes weeding twice, or thrice in a year; general pruning and pruning of mistletoes and choppons.
ii) Second, spraying against diseases and pests, twice or thrice a year.

The mass-spraying of cocoa has received a lot of attention from the government. Since its introduction, six (6) types of insecticides; Confidor, Cocostar, Cabamult, Actara 240SC,

Akate Master and Gammalin 20 (“PP KumAkate”) have been in use and are interchanged annually among cocoa growers.Application of the insecticides starts from August to October with one month break in November and commence again in December to early January.These insecticides areable to control capsid and other harmful insects. Black pod diseases and other fungal diseases are also controlled by fungicideslikeRidomil plus 72WP, Nodox Super 75, Kocide 101 and Funguronwithin spraying intervals of 3-4 weeks between May and December annually. The black pod control programme is for black pod endemic areas like Western Region and parts of Ashanti Region.



## 2.5 Cultural Practices in Cocoa Production

Many cultural practices are undertaken in cocoa production and these call for the use of agrochemicals and some biological methods. Some of the major cultural activities undertaken include; pest and disease control, weed control, fertilization, and general pruning (choppons, mistletoes, dead branches and stems). The cost of these activities must be minimized to commensurate with maximum production of dry cocoa.Wood and Lass (1998) indicated that, in a perfectly maintained farm the cocoa trees would be provided with optimum conditions for growth and yield at minimum cost. They further noted that under such farms weed, pests and diseases would be effectively controlled; the cocoa trees would be regularly pruned for sanitary purposes and their structure controlled as necessary, shade would be correctly adjusted and appropriate fertilizer would be applied.

### 2.5.1 Pests and Diseases Control in Cocoa Production

The major diseases affecting cocoa in Ghana include the Cocoa Swollen Shoot Virus Disease (CSSVD); the Black pod disease and the toxic capsid/mirid (Akate) pest. Since the detection of CSSVD, the only treatment has been the cutting down of the affected cocoa tree (Acquaah, 1999). Evidence provided by Cocoa Services Division indicates that an estimated 100,000 hectares of productive capacity was lost during the period of 1945-1990 as a result of the CSSVD attack (Amoah, 1998).Cocoa mirids also known as capsid is an insect or pest that feeds on the cocoa stems and pods.Amoah (1998), estimated losses due to capsid attacks at 20% of world crop output annually.In spite of the massive research support towards its eradication, the mirids is still widespread with the main control measure being spraying of the cocoa farms with various insecticides. To effectively deal with the threat of cocoa pests and diseases, the National Cocoa Disease and Pest Control (CODAPEC) Committee set up

decentralizedlocal government structures at the district level as conduit for implementation by supervisors (COCOBOD, 2001).

### 2.5.2 Fertilizer Use in Cocoa Production

Before the introduction of the cocoa "HI-TECH" programme in Ghana, very little was known about the financial or economic importance of chemical fertilizers in cocoa production. Although adoption of chemical fertilizer for cocoa production has been reported in other cocoa producing countries, Appiah (2000) pointed out that the use of chemical fertilizers was not widespread in Ghana for cocoa production. A study conducted by CRIG in 1990 showed that no cocoa farmer in Ghana included soil fertility maintenance in his or her farm management programme. The recent fertilizer trials conducted by CRIG for matured cocoa farms of over 30 years oldwas aimed at increasing national output in the short run through increases in yield of existing groves, and alsokeeping mature cocoa trees in older cocoa farms much longer in production (Appiah et al., 2000).From the analysis of an experimental data Appiah et al (2000) concluded that low soil fertility is a major cause of decline in cocoa yields of peasant cocoa farmers. With a four-year experimental data, they found 61.7% increase in cocoa yields on fertilized plots in the first year, 98% in the second year and 116% in the third year.

### 2.5.3 Pruning in Cocoa Production

Pruning is the removal of unwanted plants, dead woods, diseased plants, parasitic plants and choppons from cocoa farms to allow free air circulation and maintain appropriate recommended spacing in the farm. To stimulate flowering and fruit production, pruning should be a common practice for the farmer (Wood and Lass, 1998).In traditional cocoa plantings the importance of pruning has often been overlooked thus resulting in yield declines.Pruning of mature cocoa includes sanitary pruning to maintain the health and vigour of the tree and structural pruning to limit the size of the tree in order to achieve or preserve a desired shape. Effective and timely pruning are important as disease control measures. Pruning for instance becomes important when mistletoe infestation of cocoa trees becomes an increasingly serious problem (Wood and Lass, 1998).

## 2.6. Cocoa Marketing and Pricing in Ghana

The Cocoa Marketing Company (Ghana) Limited (CMC) is a wholly-owned subsidiary of the Ghana Cocoa Board (COCOBOD),and has the sole responsibility for the sale and export of cocoa beans. It also sells some of the cocoa products from the Cocoa Processing Companies

in Ghana to overseas destinations. The company had the same responsibility for coffee and sheanuts until 1991 when the internal and external marketing of the two commodities were privatized (COCOBOD, 2003).The determination of cocoa producer prices is done by the Producer Price Review Committee (PPRC). The committee comprises of COCOBOD officials, a farmer's representative, government representatives and representatives of the LBCs. Producer price policy is aimed at providing remunerative prices for cocoa farmers. It is the intention of the COCOBOD to increase the farmers' share of the free on board (fob) price to 70% by the year 2004/05 (Sarpong, 2005).

### 2.6.1 Internal Marketing of Cocoa

The COCOBOD reverted to the multiple buying system of cocoa purchasing in June, 1993 following a government decision to re-introduce competition into the internal marketing of cocoa. Prospective buyers initially apply to the COCOBOD and upon vetting by an independent committee, successful applicants are granted provisional licenses which may be converted into full licenses if COCOBOD is satisfied that the provisional licensees have adequate operational logistics for effective operation. The Licensed Buying Companies (LBCs) are required to abide by the regulations and guide-lines set out by COCOBOD. In addition to Produce Buying Company Limited (PBC Ltd), a subsidiary of COCOBOD, about twenty-five(25) LBCs and 4,600 buying centres were in operation between 1993 and 1997 (COCOBOD, 2003). Some of the LBCs included: -Adwumapa Buyers Limited, AkuafoAdamfo Marketing Ltd, Trans royal (Ghana) Limited andKuapa Cocoa Limited.

The LBCs purchase cocoa directly from farmers at a minimum producer price set by PPRC. The 2005/06 producer price wasGH¢0.90 per kilogram of dried cocoa beans. After purchasing the cocoa, the LBCs invite the Quality Control Division to grade and seal the cocoa at a fee determined by the PPRC. The graded and sealed cocoa is evacuated by the LBCs with private cocoa haulers to designated take-over points such as Tema port, Takoradi port and an inland port at Kaase in Kumasi. Officials of the Cocoa Marketing Company (CMC) take over the cocoa at the various take-over points. The LBCs are paid by the COCOBOD according to margins set by the PPRC. After the take-over, management of the cocoa becomes the responsibility of the CMC until it is shipped overseas (COCOBOD, 2003).

### 2.6.2 External Marketing of Cocoa

Most external sales of cocoa are made on standard contract. External marketing of cocoa are made on 'fob', 'cif' or 'ex store'. Ex store implies the sale of cocoa in warehouse. Such sales

are confined to the secondary market in consuming countries and the cocoa may be immediately available (spot cocoa) or available at some specified time in the future. In the case of the 'cif' and 'fob' cocoa the COCOBOD is allowed to ship the cocoa at any time during a specified two or three month period (Wood and Lass, 1998).Ghanaian cocoa beans shipped in Hessian bags (jute sacks) contains about 62.5kgs of beans. The bags are marked to indicate the country of origin, the grade and whether the cocoa is main or light crop, mid or summer crop. Cocoa from Ghana and Nigeria are sold on the basis of the nominal bag weight (shipping weight) with the buyer having a claim if the weight is not within 1.5% of the nominal weight (Wood and Lass, 1998).



## 2.7 CocoaExtension Services

The Cocoa Services Division (CSD) under COCOBOD manages all organizationalworks with cocoa in Ghana(Agricultural Extension Policy, 2003). To provide a unified extension education to farmersthe cocoa extension was merged with the Department of Agricultural Extension Services, of the Ministry of Food and Agriculture (MoFA) in 1998 (Agricultural Extension Policy, 2003).The responsibility to develop the capacity for cocoa extension was thus transferred to MOFAincollaboration with relevant agencies and private sector organizations in Ghana.However in 2001, the Government of Ghana, in consultation with the World Bank and other stakeholders in the cocoa industry initiated a programme to review the unified extension policy in order to achieve its objectives (Agricultural Extension Policy, 2003).

The aim of this policy is to effectively assist cocoa farmers to obtain sufficient cocoa farm management information from extension officers.Currently the unified extension under the MoFA provides all the necessary cocoa extension education to cocoa farmers in the country. The unified extension also provides technical expertise on both the "CODAPEC" and "HI-TECH" programmesat no costs to cocoa farmers.

## 2.8 Financial Analysis of Projects

The financial analysis takes the viewpoint of the individual participants. In financial analysis taxes are treated as cost and subsidies as a return. Market prices are normally used in financial analysis and takes in account taxes and subsidies (Gittinger, 1984). The objective of financial analysis is to evaluate the commercial viability of a project from the view point of the project

entity, that is, only expenditures incurred under the project and revenues resulting from it are taken into account (ADB, 2005 and AfDB, 2006).

Financial analysis of projects as noted by AfDB (2006) appraises the profit of an investment and estimates the profit accruing to the project operating entity or to the project participants. Therefore,for a project to be financially profitable, it must be financially sustainable as well as financially viable. If a project is not financially sustainable, economic benefits will not be realised (ADB, 2002, 2003 and 2005).AfDB(2006) noted that the financial analysis is necessary to assess the degree to which a project will generate revenue sufficient to meet its obligation, assess the incentives for the producers and ensure demand or output forecasts on which the financial analysis is based are consistent with financial charges or available budget resources.

Also related to financial analysis of project is partial budgeting.Partial budget assists the farmer to evaluate the financial effect of minor adjustment in the farm business and it is used to evaluate changes in resources that are not fixed (De Vries and Risco, 2005). Tigner (2006) points out that partial budget could eliminate or reduce costs; some returns; and cause additional cost to be incurred or returns to be received. The net effect would be the sum of positive financial effects minus the sum of negative financial effects. The main components of partial budget include additional costs, reduced returns, reduced costs, and additional returns, total of the first two and the second two, and a net difference. Most agronomic practices in the cocoa "HI-TECH" and "CODAPEC" programme, such as weed control, pruning, spraying, harvesting, pod breaking, drying and fertilizers and insecticides use and also government expenditure on the mass spraying have cost components which could be captured with partial budgeting. The net effect of the cocoa "HI-TECH" and "CODAPEC" programmes for instance can be evaluated as the difference between the positive and the negative financial effects. A positive difference indicates a potential increase in net returns and a negative difference is an estimate of the reduction in net returns of the introduction of the programme(Tigner, 2006). The net effect of the cocoa "HI-TECH" and "CODAPEC" programmes for instance can be evaluated as the difference between the positive and the negative financial effects. A positive difference indicates a potential increases in net returns and a negative difference is an estimate of the reduction in net returns of the introduction of the programme.

# CHAPTER THREE

# METHODOLOGY OF THE STUDY

This chapter presents the conceptual framework on financial viability, the hypotheses of the study and the sampling techniques employed in the data collection.

## 3.1 CONCEPTUAL FRAMEWORK

### 3.1.1 Financial Viability

The concept of financial viability as indicated by ADB (2005) and AfDB (2006)) differs from that of economic viability. Financial analysis examines the adequacy of returns of a project to the project's executing agent and other project participants.Non-revenue earning projects are not subjected to a financial viability test because by definition they do not have a positive cash flow stream.

If the project is determined to be viable the financial internal rate return(FIRR) is tested for sensitivity to the reliability of the assumptions and/or possible errors in estimating the FIRR. If the rate of return exceeds the cost of capital to finance the project it meets the test of financial viability. The rate of return of a project to the entity is indicated by the project's FIRR. Therefore, the FIRR is also the discount rate at which the net present value (NPV) of the net cash flows becomes zero (AfDB, 2006). Measures of assessment of financial viability and profitability of projects include: - Internal rate of returns (IRR), Net present value, benefit-cost ratios (BCR) and payback period (Kanshahu, 1996).

In the partial budget the additional cost incurred as a result of the "HI-TECH" and "CODAPEC" programmes, and the additional yield obtained were analyzed by setting 1999/2000 as the base year. These adjusted yields per hectare were multiplied by the producer price per kilogram for their specific crop year to derive the added revenue.

**Investment Appraisals Techniques**

The standard/classical investment appraisal techniques were employed to determine the financial viability of the programmes. Discounted cash flow methods (Undiscounted and Discounted Benefit-Cost Ratio (DBCR), Net Present Value (NPV), Internal Rate of Return (IRR) and Net benefits Investment Ratio (N/K)) were used to determine the financial viability of the "CODAPEC" and "HI-TECH" programmes. The acceptability by farmers of the technologies ("HI-TECH" and "CODAPEC") will depend, among other factorson its

profitability. The conditions of financial viability of a project or the acceptance criteria for a project or an investment are: "NPV should be positive" "IRR greater than the discount rate (cost of capital) and "discounted benefits greater than discounted costs" (Kanshahu, 1996).

The DBCR is estimated by discounting both benefits and costs of the project and when the ratio of discounted benefits to discounted cost is greater than one (1), then the project is profitable. The NPV is the present value of income/revenue generation by the project minus the present costs (Costs and benefits are discounted separately). The "acceptance criterion" being that the NPV should be positive (Kanshahu, 1996 and Gittenger, 1984).

Beside the NPV and the DBCR, an alternative test of financial viability considered was the Internal Rate of Return (IRR). This test is to determine the rate of discount at which the total discounted cash inflow (benefit) expected from the projects equals the total discounted cash outflows (costs). In other words, the IRR is the rate which makes the NPV of the project equals to zero. Technically the mathematical expressions of DBCR, NPV and IRR are:

| Type of financial ratio | Mathematical expression | Decision criterion |
|---|---|---|
| Discounted benefits-costs ratio (DBCR) | $DBCR = \frac{\sum_{t=1}^{n} B_t / (1+r)^t}{\sum_{t=1}^{n} C_t / (1+r)^t}$ | *DBCR > 1* |
| Net present value (NPV) | $NPV = \sum_{t=1}^{n} \frac{(B_t - C_t)}{(1+r)^t}$ | *NPV > 0* |
| Internal rate of return (IRR) | $IRR = A + \left(\frac{a}{(a-b)}\right)(B-A)$ | *IRR > 1* |

where $t=1, 2, 3\ldots N$

$r$ = discounting factor

$B_t$ = total income stream from project in year t

$C_t$ = total cost incurred by the project for year t

$A$ = the lower discount rate

$B$ = the higher discount rate

$a$ = the NPV calculated by using the lower rate of discount

$b$ = the NPV calculated by using the higher rate of discount

No value was placed on land in the calculations as cost of acquisition, rent, lease etc. Land has not been valued because of the difficulty in determining the appropriate value to use and

the system and procedure as terms of acquisition. The farms that were assessed for the study were farms that had been established already and so no establishment costs were involved in the cost calculation. The various labour activities and inputs that were considered under production cost for both "HI-TECH" and "CODAPEC" programmes included; chemicals; mass spraying; farmers' mass spraying; farmers' own spraying; fertilization (HI-TECH)); weeding;pruning;harvesting and gathering;pod breaking and conveyance; other inputs (cutlass, drying mat, go-to-hell etc) and management labour.

All cost calculations were on per hectare basisandalso valued at the prevailing market prices during the survey period. The cost of capital used for the financial viability test was thirty percent (30%) since that was the prevailing lending rate during the time of field survey.



**Profitability**

Tisdell (1996) suggested a slight modification to the Lynam and Herdt's model on Total Factor Productivity index (TFP)and focused on the profitability ( $P$ ) of the system:

$$P(TFP) = \frac{Value\ of\ outputs\ less\ value\ of\ inputs}{Value\ of\ inputs}$$

The profitability index (PI) explains the net returns to input cost (investment) ratio for the period under study. The profitability index is determined by dividing the net present value of each output by its initial investment. The Profitability Index is also referred to as the net benefit-cost ratio. A project is acceptable if its PI is greater than 1.0 and the higher the PI, the higher the project ranking. Sensitivity analysis was also conducted to determine the degree of relationships between the two programmes in terms of their financial viability.

**Sensitivity Analysis**

Sensitivity analysis is applied when assessing how the project outcome is affected when specific change(s) in cost(s) and benefit(s) occur (ADB, 2005). Sensitivity analysis will focus on analyzing the effects of changes in key variables on project's FIRR or NPV, the two most widely used measures of project viability. Sensitivity analysis is undertaken to help identify the key variables that can influence the project cost and benefit streams (ADB, 2005). It involves recalculating the project results for different values of major variables where they are varied one at a time. Sensitivity analysis involves four important steps:

Selecting variables which are sensitive to project decision; determining the extent to which the value of such variables may differ from the base case; calculating the effect of different

values of the variable on the project results by recalculating the project FNPV and FIRR and interpreting the results and designing mitigating actions.

Due to possible degree of uncertainty about future events, it is necessary to explore in financial analysis the parameters that are subject to risk, the source of those risks and the extent of variation. Sensitivity analysis is undertaken to identify those parameters through the Financial Net Present Value (FNPV) or FIRR (ADB, 2005). As rightly pointed out by ADB (2005), sensitivity and risk analyses should lead to improved project design.

## 3.2 HYPOTHESES OF THE STUDY

The following hypotheses were validated:

a) The Cocoa "HI-TECH" and "CODAPEC" programmes have improved cocoa productivity in Ghana.
b) The Cocoa "HI-TECH" and "CODAPEC" programmes are financially viable.
c) The Cocoa "HI-TECH" and "CODAPEC" programmes are profitable.

## 3.3 DATA COLLECTION

### 3.3.1 The Study Area

The study was undertaken in three districts from three different regions in Ghana. The districts include Ejisu-Juaben in the Ashanti Region, Twifu Hemang Lower Denkyira in the Central Region and Juabeso-Bia district in the Western Region of Ghana. These districts were purposively selected because they have benefited immensely from the Cocoa"HI-TECH" and the "CODAPEC" programmes since their introduction by the Government of Ghana in 2001.

**Ejisu-Juaben District**

The Ejisu-Juaben district is one of the eighteen districts in the Ashanti Region of Ghana.It is located in the central part of the region at a distance of about 20km east of the Kumasi-Accra trunk road. It has a total land area of about 637.4 $km^2$ representing 2.6% of the entire area of the region. The predominant economic activity is agriculture which employs about 59% of the total labour force in the district. It is estimated that about 180,931 hectares of the district's land is under agricultural cultivation (DADU, Ejisu 2001).

The population of the district is estimated at 120,968 with male and female populations of 57,529 (47.6%) and 63,439 (52.4%) respectively(Ghana Statistical Services, 2002). Cocoa is a major traditional cash crop grown in pure stand and all cocoa farmers in the district have benefited from the Government's mass cocoa spraying exercise. Evidence also suggests that the "HI-TECH" programme has been adopted by some of the cocoa farmers as a soil fertility maintenance strategy. Averagely, this has led to yield increases fromabout 5 bags per hectare to 20 bags per hectare(DADU, Ejisu 2001). Livestock and poultry keeping have not been common in the district, but dairying and piggery are increasingly becoming important.

**Twifu Hemang Lower Denkyira District**

Twifu Hemang Lower Denkyira districtis in the Central Region of Ghana a distance of about 71km from the regional capital, Cape Coast. It occupies a land area of 1,199 $km^2$ andhas a population of about110,352 with annual growth rate of 2.7 %.The male and female populations areestimated at 55,287 and 55,065. The district has a bimodal rainfall pattern anddry temperatures ranging between $30^OC$ and $34^OC$ throughout the year. The local economy is predominantly smallholder agriculture with mixed farming as the main farming system where mainstaples like plantain, cassava, cocoyam, yam, maize and rice, and cash crops include cocoa, oil palm and citrus are grown. About 70% of the district's lands are under cocoa and oil palm cultivation (DADU, THLD, 2003).

Evidence suggests that as a result of the higher farmer participation in the cocoa "HI-TECH" (Cocoa Abrabopa) programme in the district, cocoa farmerswere able to increase the district average production from 254kg per hectare to as much as 1,720kg per hectare to exceed the annual production target (DADU, THLD, 2003).

**Juabeso-Bia District**

The Juabeso-Bia district is in the Western Region of Ghana. It shares borders with Dormaa district in the North, Asunafo and Sefwi Wiawso to the East, Aowin Suaman district to the South and Ivory Coast to the West. Juabeso, the district capital is located 360 km to the North-west of Takoradi, the regional capital and the district serves as a point of entry between Ivory Coast and Ghana. It has two political constituencies; Juabeso and Bia, with a population of 245,035, representing 12.7% of theregional population, and male and female populations of 51% and 49% respectively (Ghana Statistical Services, 2002). The district has 612 communities with 2,447 dispersed settlements.

The district forms part of the county's wet semi-equatorial climate zone which is characterized by two maxima rainfall regimes of 1,250–2,000mm and mean annual temperatures of between 25$^{o}$C and 27$^{o}$C. Agriculture is the mainstay of the district's economy employing about 85% of the population. The climate, vegetation and soils in the district support the cultivation of a large variety of crops including cash crops like cocoa, coffee, and oil palm (DADU, Juabeso-Bia, 2001). Over 92%of the agricultural population is engaged in cocoa production with an average farm holding of about three (3) hectares and currently, it is the leading cocoa producing district in Ghana. The district's annual production of cocoa is estimated around 40,000 Mt (MTDP,Jubeso-Bia, 2000).With the introduction of "HI-TECH" and the "CODAPEC" programmesin the district, farmers are able to harvest as much as 1,548.7kg per hectare.Cocoa is the main revenue earner for the greater majority of the inhabitants in the district.

The locations of the selected districts are presented in Appendix A: 1 onpage 50

### 3.3.2 SAMPLING TECHNIQUES

Subjects for the study were selected through simple random and proportional sampling techniques. The lottery system without replacement was used in the selection procedure for the study. This is because of it gives each and every individual the same probability of being selected; it is also an unbiased surveying technique and ensure that the differences in cocoa farmers population in the three selected districts were fairly and adequately represented.

Three districts were purposively selected from the six cocoa regions of Ghana.These districts include Ejisu-Juaben, TwifuHemang Lower Denkyira (THLD) and Juabeso-Bia.Following this step, ten Operational Areas (O.A) were randomly chosen from each of thethree selected districts, after which three communities were randomly selected from each Operational Area. Fourcocoa farmers were then randomly selected from each of these communities and used as respondents for the study. The study used simple random sampling technique to select farmers and other respondents.

In all a total of 300 farmers and 16 officers making 316 respondents were interviewed for the entire study. A total of 80 farmers and four (4) officerswere interviewed in Ejisu-Juaben district, 120 and six officers from THLD district and 100 farmers and 6 desk officers fromJuabeso-Biadistrict. The differences in number of farmers interviewed from the district were based on the cocoa farmer population in the district.

Primary data were collected by means of a semi-structured questionnaire, which was designed and pretested prior to the main field survey. Informal discussions, focus group discussions and observation were employed alongside the questionnaireadministration in gathering primary data.

The study made use of four sets of semi-structured questionnaires. One set each was designed for the "HI-TECH" and "CODAPEC" farmers respectively and the remaining two sets, for the desk officers in charge of the "HI-TECH"and "CODPEC" programmes.The farmers' questionnaire was designed to capture both quantitative and qualitative data. The questionnaire was structured into six sections. Section one captured the general information of the respondents. Section two obtained information on the "HI-TECH"(fertilizer use) while section three dealt with the "CODAPEC" technology (mass spraying exercise). Section four sought information on various cultural and agronomic practices undertaken by the farmers. Section five obtained information on cocoa yields before and during the implementation of the "HI-TECH" and "CODAPEC" programmes, section six looked at the farmers' views about the programmes. The checklist used to interview thetwoofficers eachfromMoFA and LBCs captured among other things, the various packages associated with the "HI-TECH" and "CODAPEC" programmes including costs.

The pre-survey of twelve (12) respondents made up of seven farmers, three MOFA desk officers and two LBCs' clerkswere conducted in Twifu-Agona in the Twifu-Hemang Lower DenkyiraandKwaaso in the Ejisu-Juaben districts respectively from 22nd to 31st March, 2006. Focus group discussions were held in four cocoa communities, three (3) in the study areas and one (1) outside the study area. The details of the focus group discussion are provided in Table 3.1. The discussions provided an overview of the "HI-TECH" and "CODAPEC" programme as perceived by the farmers (respondents) in the study areas. These activities were undertaken to determine if there were questions that would not yield responses from the respondents as well as checking if the questionnairewas comprehensive enough to collect the needed information. The pre-testing helped to determine the approximate time required in completing a questionnaire. It also helped to detect the loopholes in the questionnaire and the necessary deletions and additions were made to complete the final questionnaire for the actual data collection.

The discussions also looked at the two programmes effect on yield as well as major agronomic practices like weed control, pruning, diseases and pests control and the future of Ghana's cocoa industry. The repayment of fertilizer credit facility and the privatization of internal marketing of Cocoa were also discussed at the meetings.

Table 3.1 Focus Group Discussion

| | Essieninpon (Ashanti) | TwifuMintaso( C/R) | Maase (Eastern) | Bonsu-Nkwanta (W/R) | TOTAL |
|---|---|---|---|---|---|
| Chief Farmer | 1 | 2 | 1 | 1 | 5 |
| Gang Members | 2 | 3 | 2 | 2 | 9 |
| Purchasing Clerks | 2 | 3 | 4 | 3 | 12 |
| Farmers: Female | 6 | 5 | 4 | 4 | 19 |
| Male | 4 | 3 | 2 | 3 | 12 |
| Agric. Ext. Agent | 1 | 3 | 1 | 1 | 6 |
| Total participants | 16 | 19 | 14 | 14 | 63 |

Sources: Survey Data, 2006.

The field interviews were conducted between April and July 2006. Interviews were conducted by author and ten trained enumerators from the Ministry of Food and Agriculture offices in the target districts. The interviews were conducted in the local language and at the respondents' homes or in some cases on their farms. Periodic checks were made by the author on the enumerators to ensure that proper interview procedures were followed. The primary data from the desk officers of "HI-TECH" and the "CODAPEC" programmes was obtained through informal interviews by the author. After editing the completed questionnaires 275 (42 "CODAPEC") questionnaires were used for the data capturing. The 16 questionnaires for the desk officers and other officers were used as a guide while 41 were rejected for various reasons.

The secondary data collected includedinformation on cocoa productionand agronomy in the selected districts and Ghana in general. These include: average output (kg/ha) for the various districts; average cost of various production activities (¢/kg); cost of various agro inputs (fertilizer, spraying machines, etc.) and national output (tonnes) and cocoa producer price (cedis) from 1960-2006.

The secondary data were obtained from reports of Ghana Cocoa Board (COCOBOD), International Cocoa Organisation (ICCO), Cocoa Research Institute of Ghana (CRIG), District Agricultural Development Units (DADU), District Assemblies and unpublished

research and project reports, books, journals and the internet. The specific secondary data collected and their sources are shown in Table 3.2 below.

Table 3.2 Secondary Data Sources and Information Gathered

| Sources | Information Gathered |
|---|---|
| DADUs of MoFA and District Assemblies | Basic data on the physical feature of the Districts, climate, rainfall, economic activities in the districts. |
| ICCO, COCOBOD and CRIG | Background of the programmes, trend of cocoa production in Ghana and other cocoa producing countries in the World from 1960-2006 and the components of the programmes. |



### 3.4 Data Analysis

Data analysis was conducted using Statistical Package for Social Sciences (SPSS) and Excel programmes. Much of the analysis was based ondescriptive statistics to summarise the survey results.Percentages, proportions and arithmetic means were the main descriptive statistics employed to summarise the data from the survey.In addition,partial budget analyses wereconducted to determine the financial profitability of the "HI-TECH" and "CODAPEC" programmes. Investment appraisal techniques were employed to determine the financial viability of the two programmes: - Discounted cash flow methods (Undiscounted and Discounted Benefit-Cost Ratio (DBCR), Net Present Value (NPV), Internal Rate of Return (IRR) and Net benefits Investment Ratio (N/K)), sustainability index, profitability index and sensitivity analysis were used.

# CHAPTER FOUR

# RESULTS AND DISCUSSION

This chapter presents and discussesthe results from the analysis of the survey data collected from cocoa farmers from1998/99-2005/06cocoa seasons.The chapter has four sections. Section one looks at the demographic and farm characteristic of "CODAPEC" and "HI-TECH" farmers interviewed. Section two discusses the finances of CODAPEC" and "HI-TECH" and section three presents the results of the financial analysis of the two programmes. The final section looks at the measures of profitability of the programmes.



## 4.1 Demographicand Farm Characteristics

This section presents the analysis of data collected on personal, household and farm characteristics of respondents. The details are presented in Table 4.1.

Table 4.1 Demographic Characteristics of Respondents

| | Frequency | Percent |
|---|---|---|
| 1. Gender | | |
| Male | 206 | 79.5 |
| Female | 53 | 20.5 |
| 2. Marital Status | | |
| Married | 225 | 86.9 |
| Divorced | 14 | 5.4 |
| Widow | 14 | 5.4 |
| Single | 6 | 2.3 |

| 3. Household Family Size and Dependant | | | | |
|---|---|---|---|---|
| | Ejiso | THLD | Juaboso | Average |
| Average Family size | 9 | 10 | 9 | 9 |
| Average Dependant size | 7 | 8 | 7 | 7 |
| Average children in school | 3 | 4 | 4 | 4 |
| Average adult dependant | 3 | 4 | 4 | 4 |
| Average supporting dependant | 2 | 3 | 3 | 3 |

Source: Survey Data, 2006.

From Table 4.1 two hundred and six (206) of all respondents representing 79.5% were males and the remaining 20.5% were females. This results indicates that cocoa farming is male dominated and this could be due to the labour intensive nature of the enterprise, land tenure and holding systems in Ghana. Concerning marital status, the table shows that 86.9% of the respondents were married and 5.4% were divorced.

Cocoa families are characterized by large sizes because of need forlabour. The study revealed two (2) and thirty (30) as the minimum and maximum family sizes respectively (Table 4.1). The mean dependants size was seven (7) and the number of dependants who regularly assisted their families in their farming activities was three (3). (Table 4.1)



Regarding education level attained by respondents, the survey revealed that most of them, about 88.% had attained basic education ranging from primary level to middle school or Junior high School level(Fig.4.1).About10% and 2% hadcompleted secondary education and tertiary institutions respectively.

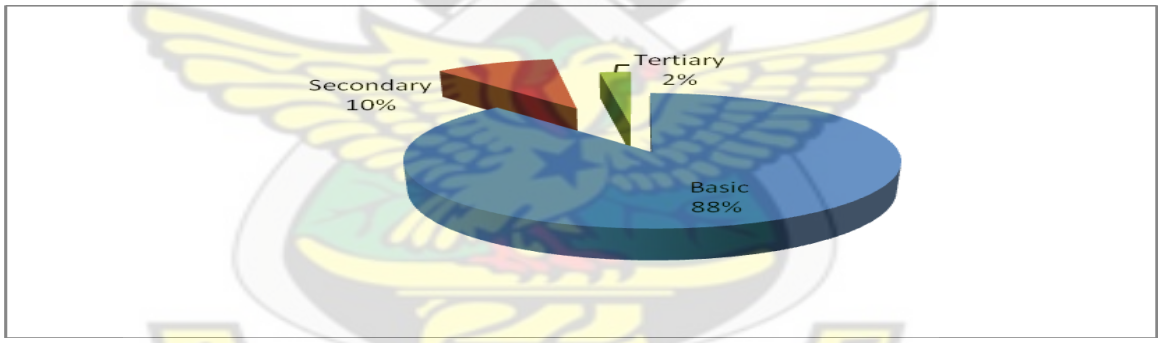


Figure 4.1 Educational Levels of Respondents

Source: Survey Data, 2006.

### 4.1.1 Farm Holdings

The total farm holdings of the respondents were 1,840.3hectare. Respondents under “HI-TECH” programme had a total holding of 457.55 hectares (24.78%) andthat of “CODAPEC” was1,382.75 hectares (75.13%). THLD had the largest holding of 199.77ha (10.86 %) of the total holdingunder the “HI-TECH” programme while Juabeso farms under ‘HI-TECH” was 110.40 ha (6.0%) and that of Ejiso was 104.79 ha (5.70%).Juabeso recorded the largest average holding of 9.28 ha as against 5.98 ha of THLD hectares. For “CODAPEC” Juabeso had the largest total farm holding of 635.13ha (34.51%) (Table 4.2)

Table 4.2 Farm Holdings

| District | Total Farm Size (Ha) | Average Holding (Ha) | Percentage of Holding under HI-TECH | Percentage of Holding under CODAPEC |
|---|---|---|---|---|
| Ejiso | 417.50 | 6.14 | 25.10 | 74.90 |
| THLD | 634.20 | 5.98 | 31.50 | 68.50 |
| Juaboso | 788.60 | 9.28 | 19.40 | 80.60 |
| Average | - | 7.05 | 24.87 | 75.13 |
| Total | 1,840.30 | - | | |

Source: Survey Data, 2006



## 4.2 InputsUsein "HI-TECH" and "CODAPEC" PROGRAMMES

### 4.2.1 Funding

Figure 4.2 provides the distribution of respondents according to sources of funding for inputs procurement and application. The survey data indicated that 119 out of the 217 farmers interviewed for the "HI-TECH" representing 55.0% enjoyed the government Cocoa fertilizer credit package through their District Assemblies;26.0% financed the programme through their personal savings and 19.0% also enjoyed credit from other fertilizer dealers.

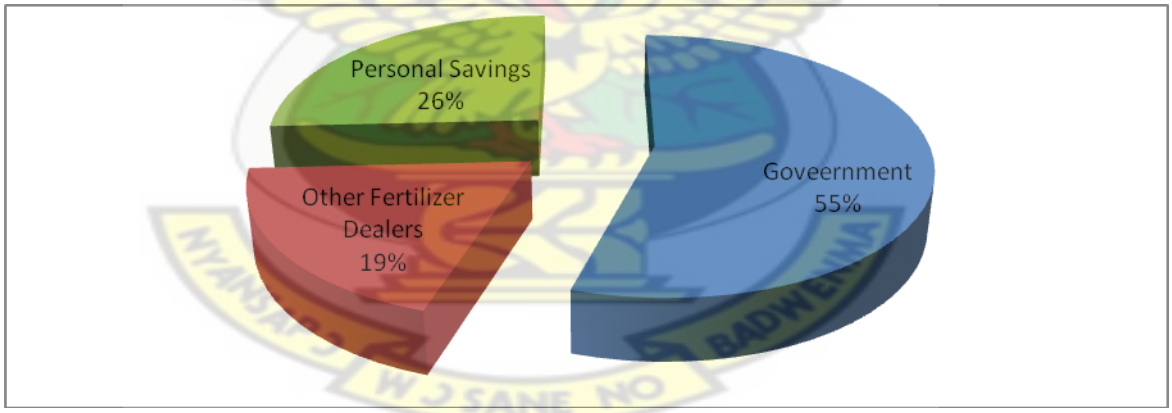


Figure 4.2 Sources of Funding for Inputs Procurement and Application
Source: Survey Data, 2006

It was observed from the data that a total of 161 farmers (67.6%)who received credit from government and other fertilizer dealers had repaid the loansfully (Fig.4.3). About 19% hadrepaid over 50% of the amount owed and the remaining 13% had repaid one -third of their indebtedness as at the time of the survey.

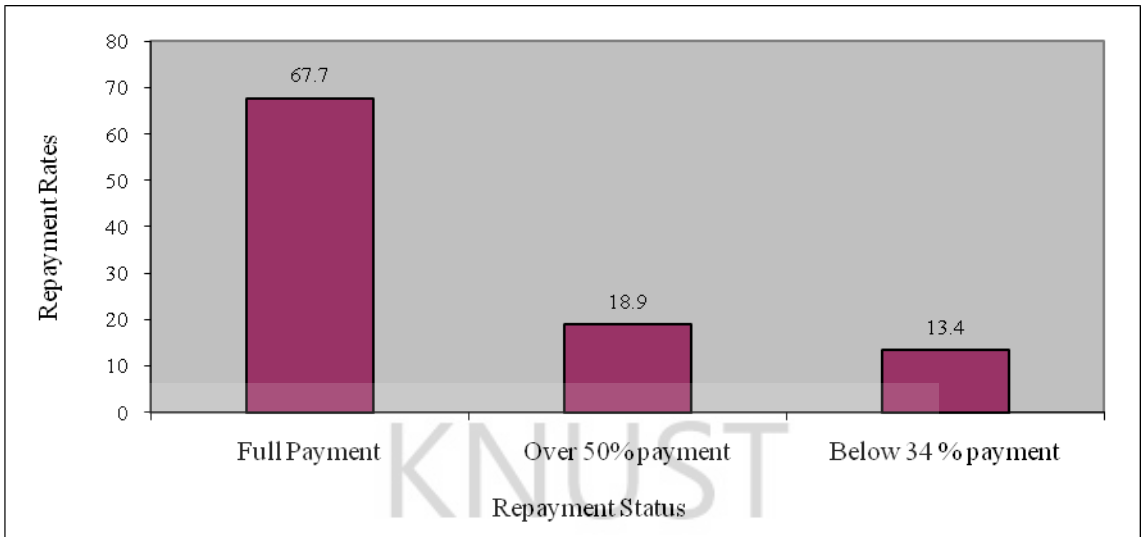


Figure 4.3 Repayment Rates of Fertilizer Credited by Farmers

Source: Survey Data, 2006

The study sought information, through the respondents on the main types of farm workers for cocoa farming in the study areas. The responses were similar across the three districts.In all cases, cocoa farms were managed by either caretakers or farm owners themselves(self-employed). These two groups of farm managers employed both family and "casual labour" which isusually on *by-day* or contract basis.

### 4.2.2 Mass Spraying Frequencies

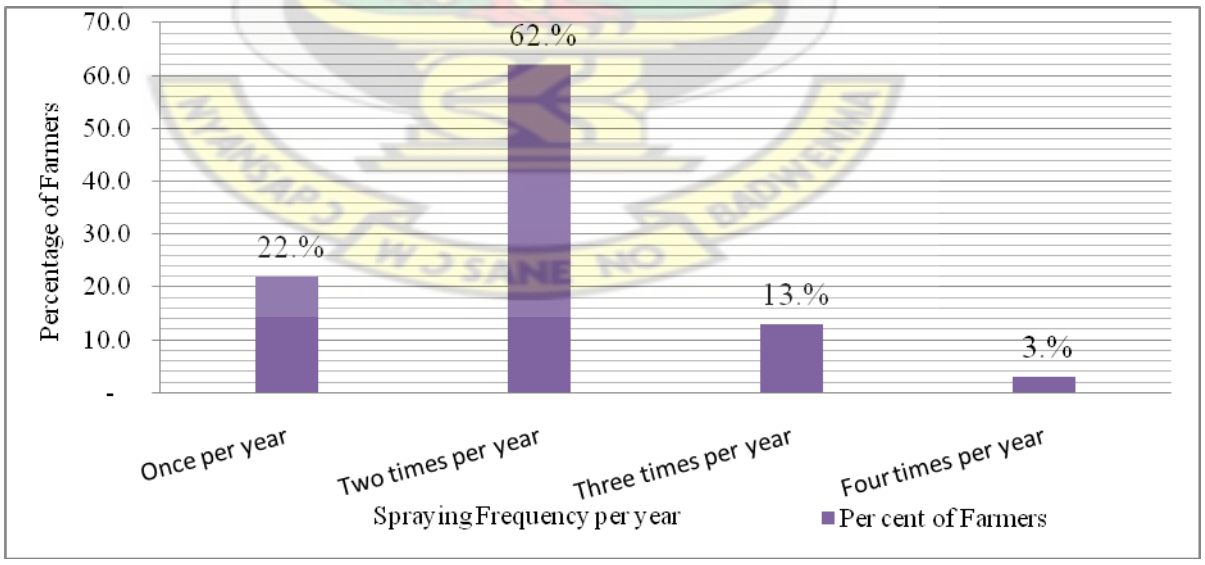


Figure 4.4 Mass Spraying Frequencies

Source: Survey Data, 2006

It may be evident from Figure 4.4 above that 22% of the farmers interviewed had their farms sprayed once during the mass spraying exercise while 62% enjoyed spraying twice also under the mass spraying exercise in a season. Those who had between three and four times spraying are the farmers from Juaboso (Western region) where they were into black pod control.

### 4.2.3 Farmers' Own Spraying

In addition to the mass spraying exercise, majority of the"HI-TECH" farmers sprayed their farms at their own expense. Figure 4.5shows that 73.6%and76%of the farmers interviewed in Ejiso and THLD respectively sprayed at their own cost. In Juaboso all the 69 farmers interviewed sprayed against capsid and the reason was that the mass spraying programme covered black pod controlonly in that region.

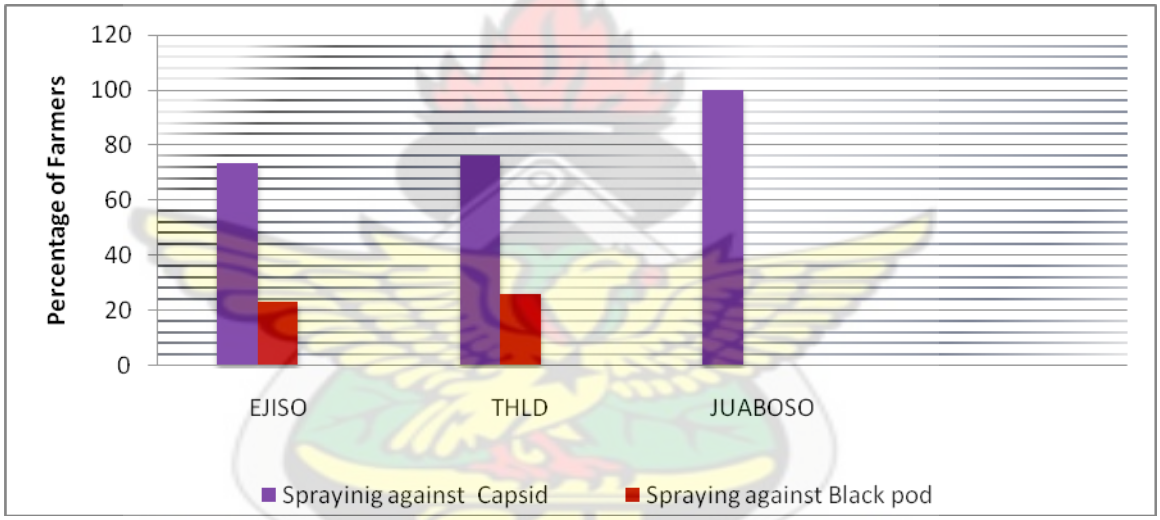


Figure 4.5 Spraying Against Black Pod and Capsid by "HI-TECH" Farmers

Source: Survey Data, 2006

### 4.2.4 Quantities of fertilizers Used by "HI-TECH" farmers per Season

Quantities of fertilizers used by "HI-TECH" participants in each district from 2000/01-2005/06 cocoa season are presented in the Figure 4.6 below. Farmers in THLD used a total of 5,862 bags as against 5,520 bags for Juaboso and 2,592 bags for Ejiso respectively. A total of 13,971bags of cocoa fertilizers were used by 217 farmers during the period of the study.Average usage per season stood at 977 bags for THLD, 920 bags for Juaboso and 432 for Ejiso. The respondents in all the study areas adhered to the rate of 375kgs (7½bags) per hectare or 150kgs (3bags) per acre of cocoa fertilizer as recommended by CRIG.

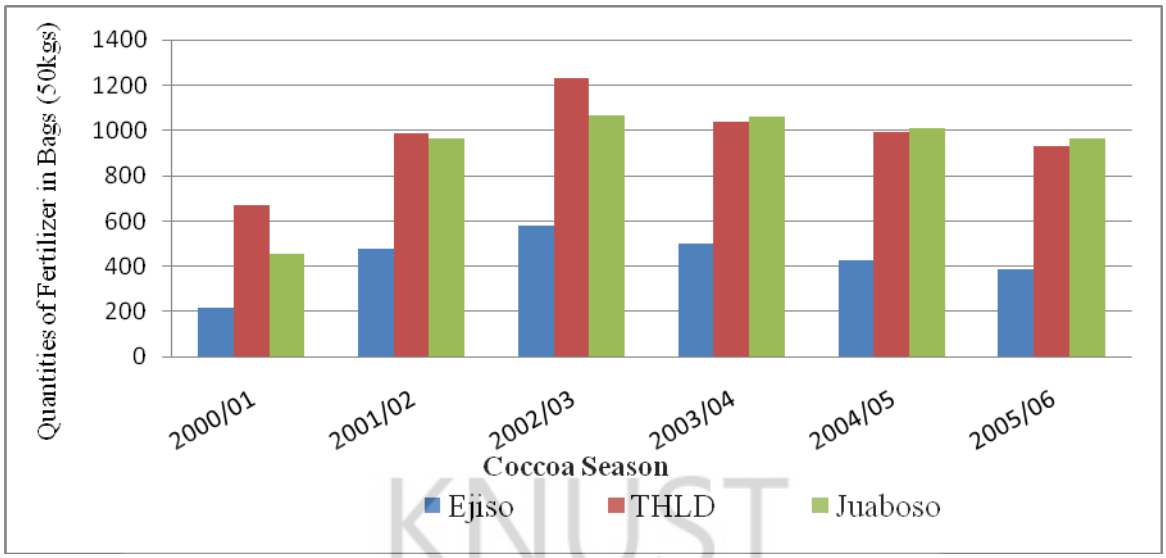


Figure 4.6 Quantities of Fertilizers Used By "HI-TECH" Farmers per season
Source: Survey, 2006

### 4.3 Cocoa Production and Yield under "HI-TECH and "CODAPEC"

From Figure 4.7 yield increased from 321.17 kg per ha in 1999/2000 to 846.23 kg/ha (0.846 mt/ha) in 2000/01 through 1,237.13 kg/ha (1.24 mt/ha) in 2003/04 season and then to 1,679.33 kg/ha (1.679 mt/ha) in 2005/06 crop year for the "HI-TECH" programme. This showed over 422% increase at the end of the sixth year and about 400% over the national average of 350 kg/ha. Yield from the "HI-TECH" farms exceeded those of the "CODAPEC" farms by 125.96% (471.73 kgs) in the first year (2000/01), 146.78% (573.17 kgs) in the second yearand by the sixth yearthe difference was 147.45% (1,001.53kgs).

The "CODAPEC" farms also showed a slight increase during the periodfrom 311.70kg per ha in 1999/2000 to 677.80 kgs per ha at the end of the sixth year, an increase of 117.45% which was an indication that pest and disease control contributed to yield increase in cocoa production in Ghana. The "HI-TECH" programme increased in yield in its first year at the rate of163.48% and dropped to 35.57% in the second year and then to 71.67% in the sixth year. The "CODAPEC" programme on the other hand increased at the rate of 20.15% after its implementation, then dropped to 5.13% in the second year and by the sixth year it had risen to 29.48%. The average growth rates of yield increases were 51.72 and 19.46% per season for "HI-TECH" and "CODAPEC" respectively. These differences may be due to the fertilizer used, extra spraying and adherence to good agricultural practices by "HI-TECH" farmers'.

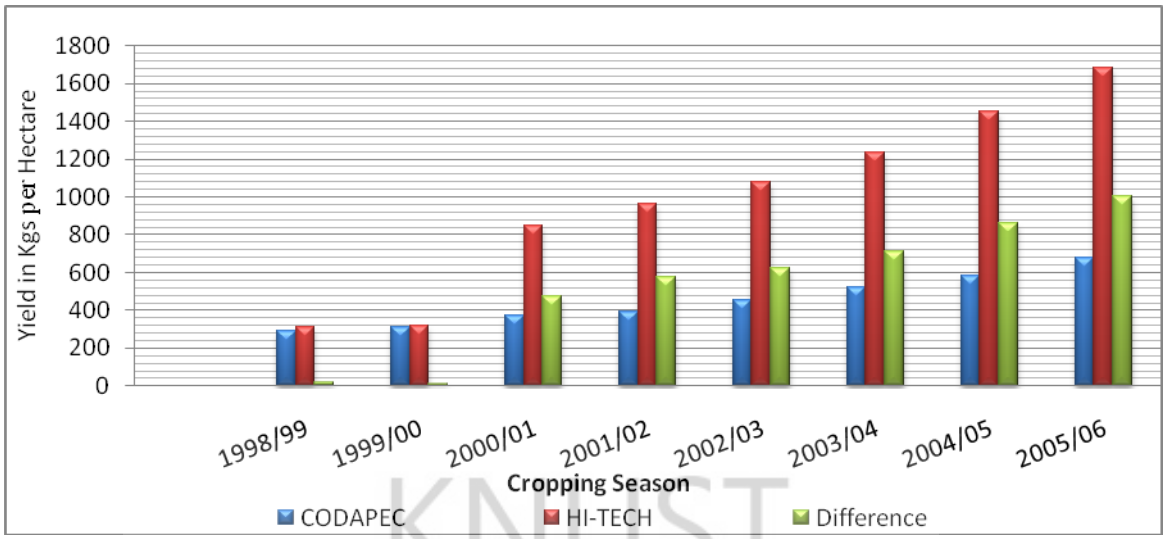


Figure 4.7 Yield Trends of"HI-TECH" and "CODAPEC" Farms
Note:1998/99 and1999/2000were Before CODAPEC and "HI-TECH" were implemented.
Source: Survey Data, 2006

## 4.4 Cost and Returns Associated with Cocoa Production under"HI-TECH" and "CODAPEC" Programmes.

This section presents the analysis of cost and returnsper hectare per annum involved in the Cocoa "HI-TECH" (Fertilizer use) and "CODAPEC" (Diseases andPest control) programmes in the study area.

### 4.4.1 Farmers' Contribution to the Mass Spraying Programme.

Even though not part of the condition for the original mass spraying exercise, it became evident from the study that farmers had informally agreed with the spraying gang to pay between GH¢0.05 and GH¢0.10 per fill or tank of mist blower/knapsack sprayed to support expenses related to handling, transportation, ignition, plugs,among others. In 2000/01 season "HI-TECH" and "CODAPEC" farmers contributed 23.5% and 17.2% of the total cost respectively to the mass spraying exercise in the form of water, feeding of spraying gang, off-loading and onloading of the spraying machines. The percentage contribution of "HI-TECH" farmers ranged from 20%-24% and that of "CODAPEC" 13%-17% for the study period. The average contributions of the farmers for the period were 21.2% and 15.4% for "HI-TECH" and "CODAPEC' farmers respectively for the study period (Figure4.8).

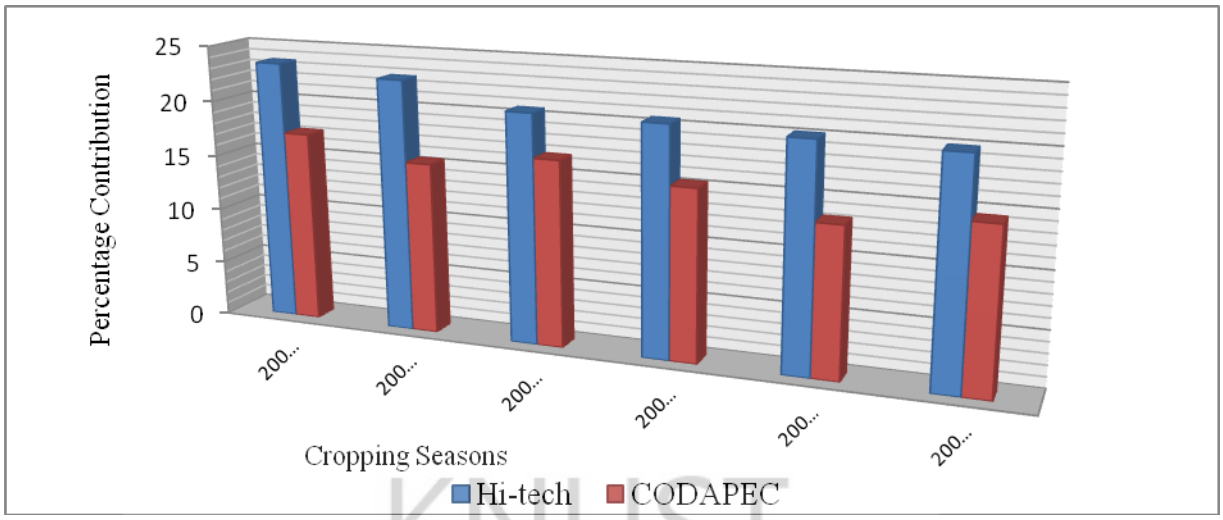




Figure 4.8 Farmers Contribution to the Mass Spraying Exercise

Source: Survey Data, 2006

### 4.4.2 Production Costs perHectare for "HI-TECH" and "CODAPEC" Farms

The various agronomic activities that were carried out and agro inputs used under the "CODAPEC" and "HI-TECH" programmes were valued at the prevailing market prices during the survey period. Table 4.3 shows the total production costs incurred per hectare under the two programmesfor the period between 2000/01 to 2005/06 cocoa cropping seasons.Table 4.3 also depicts that cost of production for both programmes per hectare increased annually at average growth rates of 14.83% and13.64% for "HI-TECH" and "CODAPEC" respectively.The total production cost for "HI-TECH" farms per ha were more than twice that of the "CODAPEC" farms mainly due to the fertilizer usage under the "HI-TECH" programme (Table 4.3 column 4). Specific operational activities and their associated costs are presented in Appendices9 and10

Table: 4.3 Total Cost of Production for "HI-TECH" and "CODAPEC" Farms per Hectare

| Cropping Season | Production Cost (GH¢) per Hectare | | Differences in Production cost (GH¢) per hectare |
|---|---|---|---|
| | HI-TECH - GH¢ | CODAPEC-GH¢ | |
| 2000/01 | 244.97 | 116.67 | 128.30 |
| 2001/02 | 309.63 | 138.97 | 170.66 |
| 2002/03 | 362.45 | 156.82 | 205.63 |
| 2003/04 | 403.80 | 174.92 | 228.88 |
| 2004/05 | 441.67 | 196.10 | 245.57 |
| 2005/06 | 480.98 | 220.90 | 260.08 |

Source: Survey Data, 2006

### 4.4.3 Returns per hectare for "HI-TECH" and "CODAPEC" Programmes.

The summary for the "CODAPEC" and "HI-TECH" costs and returns are presented in Appendices9 and 10respectively. The total costs were compared with their respective revenues to arrive at the net return to each programme.

The net return per hectare to the "CODAPEC' farmers before the introduction of the programme was GH¢8.13 in 1998/99 cropping season and this declined by 22.62% to GH¢6.63 in 1999/2000 cropping year. It then increased to GH¢13.476 (103.17%) per hectare in 2000/01 season and by the end of the sixth year, it had reached GH¢389.12. It should be noted that these aggregate figures of net returns revealed the profitability of the whole production process with respect to adherence to CRIG procedures on "CODAPEC" programme. Also included in this profit is the government cost on the mass spraying exercise. It was also observed that during the study period producer price of cocoa also increased from GH¢0.225 per kg in 1999/00 to GH¢0.3475 per kg in 2000/01; then to GH¢0.62 in 2001/02and stabilized at GH¢0.90 per kg in 2003/4 to 2006/7.

Appendix 10 shows the net return per hectare of GH¢49.10 to the "HI-TECH" farmers using fertilizer as input in their farming operation in the first year. This figure shows a percentage increase of 264.53% above "CODAPEC" farms and 478.99% over and above the periods before the implementation of the "COPDAPEC" and the "HI-TECH" programmes.By the end of the sixth year "HI-TECH" programme had realized a net return of GH¢1,030.41 per hectare as against GH¢389.12 per hectare for "CODAPEC" programme. This is based on good agricultural practices adoption and fertilizer use by the "HI-TECH" farmers. Refer to Appendices 9 and 10 for the details on costs and returns for the two programmes.

## 4.5 Financial Analysis

The second objective of this section is to investigate the added costs, (incremental cost), addedrevenue (incremental revenue) and incremental net benefit accrued to cocoa farmers and the nation from the new technological improvement. Table 4.4 shows that the "CODAPEC" package with its additionalcoststo the farmers also increased the farmers' output per ha as well as incremental net return. The study shows an additional increase in output of 62.8kgs per ha (20.15%) in the first year(2000/01), then to 78.8kg in 2001/02 and by the end of 2005/06 crop year it has reached 366.10kgsper ha(117.45%). From Table 4.6"CODAPEC" programme in the first and second years of operation registered net loss of GH¢26.31 and

GH¢19.60 per ha respectively. This negative trend changed to positive net returns ofGH¢32.91 in 2002/03 to GH¢185.62 in 2005/06.

Table: 4.4IncrementalCosts and Returns Analysisper Hectare under "CODAPEC" Programme.

| Description | 2000/01 | 2001/02 | 2002/03 | 2003/04 | 2004/05 | 2005/06 |
|---|---|---|---|---|---|---|
| Mass Spraying | | | | | | |
| Farmer's contribution | 1.13 | 1.23 | 1.60 | 1.77 | 1.87 | 2.23 |
| Farmer spraying | | | | | | |
| *a.. Insecticide* | 0.00 | 1.57 | 6.18 | 6.84 | 9.33 | 8.33 |
| *b. Fungicide cost/ha* | 0.00 | 0.42 | 1.84 | 1.84 | 2.77 | 4.27 |
| Weeding/ha /yr | 4.67 | 6.67 | 9.50 | 13.00 | 16.50 | 20.17 |
| Pruning | 26.07 | 22.67 | 20.17 | 18.00 | 16.67 | 16.67 |
| Harvesting/ha | 3.50 | 6.43 | 7.73 | 9.87 | 11.83 | 13.83 |
| Pod breaking | 2.93 | 5.37 | 6.17 | 7.83 | 9.87 | 11.43 |
| Conveyance/ha | 1.93 | 5.07 | 7.23 | 7.40 | 11.37 | 14.20 |
| Dry cost /ha | 1.93 | 3.80 | 5.97 | 7.60 | 9.33 | 11.80 |
| Marketing/ha | 1.80 | 5.80 | 7.20 | 9.67 | 11.70 | 13.87 |
| Other input(fixed cost) | 2.17 | 5.50 | 6.87 | 9.30 | 11.13 | 15.13 |
| Mgt cost/ha | 2.00 | 3.93 | 4.87 | 8.40 | 10.27 | 11.93 |
| Total Added Cost | 48.13 | 68.45 | 85.32 | 101.52 | 122.63 | 143.87 |
| Total Added Yield/ha | 62.80 | 78.80 | 139.10 | 211.70 | 274.20 | 366.10 |
| Producer Price/kg | 0.35 | 0.62 | 0.85 | 0.90 | 0.90 | 0.90 |
| Total Revenue | 21.82 | 48.86 | 118.24 | 190.53 | 246.78 | 329.49 |
| Net Return | -26.31 | -19.60 | 32.91 | 89.01 | 124.15 | 185.62 |
| Gov't's contribution | 5.43 | 7.00 | 8.00 | 9.67 | 11.83 | 12.50 |
| Profitability index | -0.56 | -0.35 | 0.27 | 0.71 | 0.84 | 1.11 |

**Note**:Average Profitability index (Average net benefit-cost ratio) =0.404
1999/2000 Crop year has been set as base year for the "CODAPEC" programme.
Source: Survey Data, 2006

Table 4.5 shows that the "HI-TECH" farmers on the other hand recorded an additional yield of 525.06kgs per ha in 2000/01 crop season and increased to 642.50kgs/ha in 2001/02 and by the end of 2005/06 crop season 1.358mt/ha (1,358.16kgs/ha) had been realized from the "HI-TECH" farms. This shows a yield increase of 317% and388% over and above that from "CODAPEC" farms and national average respectively.The incremental cost increased from GH¢185.10 in 2000/01 to GH¢236.75 in the 2001/02 and to GH¢401.07 in the 2005/06 cropping season.Additional revenue realized in 2000/01 stood at GH¢183.77and rose to GH¢1,222.34in 2005/06 cocoa season.From Table 4.5 the "HI-TECH" farmers'realizeda net loss of GH¢1.35 inthe first year of the programme (2000/01)and this was because the fertilizer used had not fully been taken up by the crop. However, positive returns were realized in the succeeding years (GH¢161.60 in the second year(2001/02) and GH¢821.28 in 2005/06).

Table 4.5IncrementalCosts and Returns Analysisper Hectare under"HI-TECH" Programme.

| Description | 2000/01 | 2001/02 | 2002/03 | 2003/04 | 2004/05 | 2005/06 |
|---|---|---|---|---|---|---|
| Mass Spraying | | | | | | |
| Farmer contribution | 2.30 | 2.67 | 3.33 | 3.73 | 4.23 | 4.50 |
| Fertilizer cost | 119.97 | 146.50 | 167.35 | 178.43 | 187.33 | 196.75 |
| Farmer spraying | | | | | | |
| *a. Insecticides* | 3.40 | 9.83 | 11.97 | 14.70 | 18.33 | 18.30 |
| *b. Fungicide* | 1.42 | 1.65 | 2.88 | 3.95 | 4.75 | 5.72 |
| Weeding/ha /yr | 7.52 | 10.57 | 13.10 | 17.33 | 22.10 | 27.10 |
| Pruning | 28.67 | 24.33 | 22.03 | 19.33 | 17.67 | 17.67 |
| Harvesting | 3.53 | 4.70 | 8.30 | 9.67 | 15.17 | 19.67 |
| Pod breaking | 2.97 | 5.93 | 9.97 | 13.27 | 15.97 | 17.53 |
| Conveying | 2.00 | 4.70 | 9.70 | 11.63 | 15.07 | 18.20 |
| Drying | 2.47 | 0.90 | 5.70 | 8.61 | 11.63 | 15.03 |
| Marketing | 2.40 | 4.30 | 7.47 | 12.67 | 13.53 | 16.77 |
| Management | 3.17 | 7.80 | 10.20 | 13.20 | 17.00 | 23.73 |
| Other Input (fixed cost) | 5.30 | 10.87 | 15.07 | 18.13 | 19.67 | 20.10 |
| Total Added cost | 185.12 | 236.75 | 287.07 | 324.65 | 362.45 | 401.07 |
| Added yield /ha | 525.06 | 642.50 | 754.16 | 915.96 | 1,128.6 | 1,358.16 |
| Price/kg | 0.35 | 0.62 | 0.85 | 0.90 | 0.90 | 0.90 |
| Added Revenue | 183.77 | 398.35 | 641.04 | 824.36 | 1,015.77 | 1,222.34 |
| *Net Return* | -1.35 | 161.60 | 353.97 | 499.71 | 653.32 | 821.28 |
| Gov't contribution | 7.50 | 9.10 | 12.70 | 14.73 | 16.93 | 19.07 |
| Profitability index | -0.05 | 0.62 | 1.14 | 1.43 | 1.68 | 1.91 |

**Note:** Average Profitability index (Average net benefit-cost ratio=1.346)
1999/2000 Crop year has been set as base year for the "HI-TECH" programme.
Source: Survey Data, 2006

It was observed that whilst the additional cost of production on the "HI-TECH" farm was high during the period under study, that of "CODAPEC" farms was relatively low and that, the fertilizer used in the "HI-TECH" farms contributed to the higher production cost.These figures do not include government expenditure on the mass spraying.Figure 4.9 below is a graphical presentation of the net returns (benefits) derived from"CODAPEC" and "HI-TECH" operating farms over a six (6) year period.

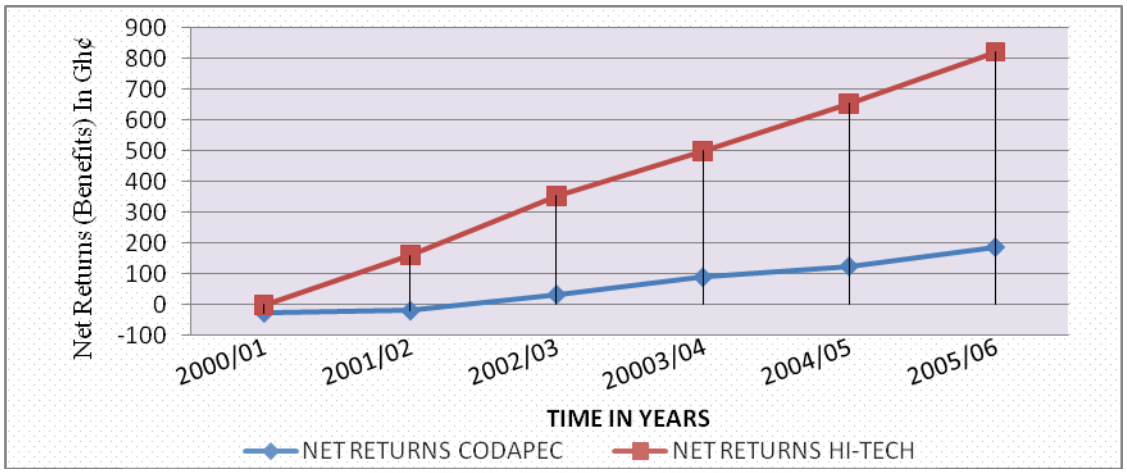


Figure 4.9 Net Returns (Benefits) to "CODAPEC" and "HI-TECH" Programmes

Source: Survey Data, 2006



### 4.6. Measures of FinancialViability

The section provides results and discussions on the profitability index, sustainability index, investment appraisal and sensitivity analysis.

#### 4.6.1. Profitability Index (PI)

The incremental cost and incremental benefit were used in the computation of the profitability index.Figure 4.10 below provides a graphical analysis of the profitability indices of the two projects over a six year period.

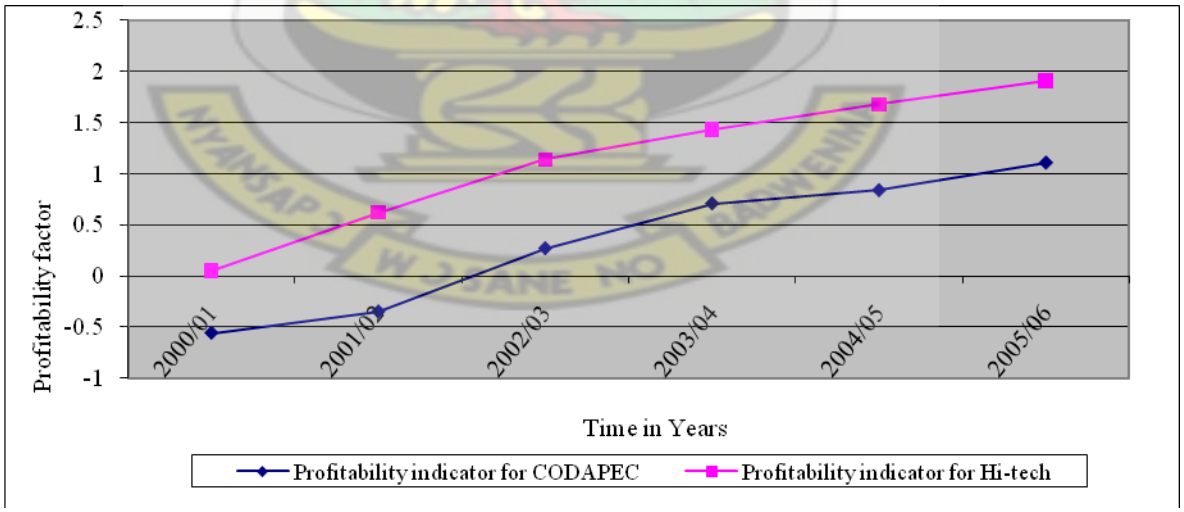


Figure 4.10 Profitability Indexes for "CODAPEC" and "HI-TECH" Programmes

Source: Survey Data, 2006

Both programmes satisfy the Tisdell's profitability condition except that in the first and second years of "CODAPEC" programme profitability indicator showed a negative sign (a financial loss).The"HI-TECH" programme in its first year of operation also recorded afinancialloss of 5%, gained 62% in second year and then above 100% from third to the fifth year to almost 200% in the sixth year. Therefore, from financial point of view the "HI-TECH" programme exhibited a very high level of profitability than the "CODAPEC" programme.It can be concluded that returns from "HI-TECH" farmswas always greater than those from "CODAPEC" farms (Fig: 4.10).

What is necessary is to find out what happens when conditions which are linked to production (output & input) and marketing (cost, price and revenue) are adversely affected in the near future.

### 4.6.2 Results of Investment Appraisal.

The acceptability by farmers of the technologies ("HI-TECH" and "CODAPEC") will depend, among other factors on its profitability. The conditions of financial viability of a project or the acceptance criterion for a project or an investment are that the "NPV should be positive", the "IRR should be greaterthan the discounted rate (cost of capital)" and "discounted benefit greater than discounted cost".Table 4.6 presents the summary of the computations of the projects cash flow. For details see appendicesA14 and A15.

Table 4.6below provides the summary of the results from the investment appraisal of one hectare cocoa farm under "HI-TECH" and "CODAPEC" programmes.From Table 4.6 at an opportunity cost of capital of 55% which is highly above the current bank interest rate for agricultural projects (30%), the discounted benefitsfor both programmes exceeded the discounted costs and made both programmes financially attractive for investment at this rate. When the rate was increased to 85% the "CODAPEC" discounted cost exceeded the discounted benefit and made it non profitable at this rate but that of the "HI-TECH" programme was still profitable. Therefore, the benefit-cost ratiosat 55% (discounted and undiscounted)were greater than one (1), for both programmes indicating that the two programmes were profitable and viable. The net present value (NPV) at 55% and 85% discounted rates were positive (GH¢526.96 and GH¢218.23) for "HI-TECH" programme. The internal rates of return (IRR) were found to be 106.21% and 82.78% for the "HI-TECH" and "CODAPEC" programmes respectively. This means that the two programmes have an IRR

greater than the current market rate of interest in the country; therefore these rates (106.21% and 82.78%) are the highest rates of interest the "HI-TECH" and "CODAPEC" farmers respectively can afford to pay, without running at loss if all investment funds are borrowed.

Table 4.6. Financial Viability of cocoa "HI-TECH" and "CODAPEC"

| **Indicator:** | **"HI-TECH"** | **"CODAPEC"** |
|---|---|---|
| Total Discounted Cost (30%) | GH¢1,854.98 | GH¢613.98 |
| Total Discounted Benefit (30%) | GH¢3,620.95 | GH¢782.93 |
| Discounted benefit-cost ratio (30%) | 1.95 | 1.28 |
| Total Discounted Cost (55%) | GH¢586.00 | GH¢201.41 |
| Total Discounted Benefit (55%) | GH¢1,112.96 | GH¢236.62 |
| Discounted benefit-cost ratio (55%) | 1.90 | 1.17 |
| Total Discounted Cost (85%) | GH¢305.88 | GH¢99.67 |
| Total Discounted Benefit (85%) | GH¢524.11 | GH¢96.86. |
| Discounted benefit-cost ratio (85%) | 1.71 | 0.97. |
| Total Undiscounted Cost | GH¢48,693.76 | GH¢22,789.88 |
| Total Undiscounted benefit | GH¢86,273.18 | GH¢25,739.60 |
| Benefit-cost ratio (Undiscounted) | 1.77 | 1.13 |
| Net Present Value (30%) | GH¢4,970.30 | GH¢168.95 |
| Net Present Value (55%) | GH¢526.96 | GH¢35.20 |
| Net Present Value (85%) | GH¢218.23 | GH¢ (2.81) |
| Internal rate of return (IRR) (55% & 85%) | 106.21% | 82.78% |

Source: Survey Data, 2006

The IRR also describe the rate of growth of the investment and it is the highest rate of interest one can afford to pay without running at loss, supposed all farming funds are borrowed. Therefore "CODAPEC" farmers can borrow up to 82.78% interest rate, above this rate the programme would not be profitable. The "HI-TECH" programme can contract a loan up to an interest rate of 106.21% without running at loss.

Using ranking by inspection of investment based on the cash flow reveals that, although the Net present value for "HI- TECH" programme in the first year was negative (GH¢6.06) and that of the "CODAPEC" programme in the first and second years were negative (GH¢24.52) and (GH¢11.95) respectively, the "HI-TECH" programme is more desirable because it continues to earn more money (net benefit or NPV) for the project life

### 4.6.4 Sensitivity Analysis

The financial profitability/viability indicators of the projects were examined to evaluate how sensitive they are to changing market/policy factors. Two main assumptions were made. These include: -producer price of cocoais stabilized for ten (10) years after the first ten (10) years of operation of the programme and subsidies on cocoa fertilizers are withdrawn.

Table 4.7 provides a summary of the results from the sensitivity analysis of cocoa production under the two assumptions. In the face of stable cocoa price (produce price) for ten (10) years, the benefit-cost ratio discounted at 85% and undiscounted for "CODAPEC" programme was less than one (1) whilst NPV at 85% was also negative(GH₵0.511), indicating that the programme was neither profitable nor viableunder this assumption, but the internal rate of return was found to be 84.66%.which is also less than the discounted rate of 85% used in the calculations. The "HI-TECH" programme on the other hand, showed a positive NPV at 55% and 85% discounted rates (GH₵561.67 and GH₵226.1) with internal rate of return of 105.29% and both the discounted and undiscounted benefit-cost ratios were greater than one(1) (Table 4.7). This makes the "HI-TECH" programme more resistant in terms of profitability, viability and sustainability than the "COPADEC" programme.

Table 4.7Sensitivity Analysis on cocoa "HI-TECH" and "CODAPEC".

| Programme | **"HI-TECH"** | | **"CODAPEC"** | |
|---|---|---|---|---|
| **Assumption I**:- Stabilized cocoa producer price | | | | |
| Indicators \ Rates | ***55%*** | ***85%*** | ***55%*** | ***85%*** |
| Net present value (NPV) | GH¢561.67 | GH¢226.81 | GH¢44.13 | (GH¢0.511) |
| Discounted cost | GH¢586.00 | GH¢305.88 | GH¢201.41 | GH¢99.67 |
| Discounted benefit | GH¢1,147.66 | GH¢532.69 | GH¢245.55 | GH¢99.15 |
| Discounted benefit-cost ratio | 1.96 | 1.74 | 1.22 | 0.99 |
| Internal rate of return (IRR) | 105.29% | | 84.66% | |
| **Assumption II**:- Fertilizer subsidy withdrawn (removed) | | | | |
| **Discounted rates** | ***55%*** | ***85%*** | | |
| Net present value (NPV) | GH¢262.63 | GH¢63.60 | | |
| Total Discounted Cost | GH¢850.32 | 524.11 | | |
| Total Discounted Benefit | GH¢1,112.96 | 460.51 | | |
| Discounted benefit-cost ratio | 1.31 | 1.14 | | |
| Internal rate of return (IRR) | 94.59% | | | |

Source: Survey Data, 2006

The findings of the study compare favourably with those from related study, Agyeman et al (2003) at a discount rate of 10%, estimated 16.2% as the internal rate of return for Modified Taungya System (MTS) in a study that cover several districts in Ghana.

The second assumption where fertilizer subsidy was withdrawn, the "HI-TECH" programme showed positive NPV of GH¢262.63 and GH¢63.60 at discount rates of 55% and 85% respectively with an internal rate of return (IRR) of 94.59%. Therefore, if resource could be available to the farmers, the "HI-TECH" which combined the diseases and pest control to fertilizer use is more profitable, viable and sustainable. (See Appendix 11-15for details).

The "HI-TECH" programme whichcombines diseases and pests control (CODAPEC), fertilizer application to improve soil fertility and other good agricultural practices (weed control, pruning, timely harvesting etc.)is more profitable, viable and sustainable. This was because from the investment appraisal test conducted; the benefit-costs ratio (discounted and undiscounted) was greater than one (1). The NPV was also positive for the assumptions made and the IRR too greater thanthe discounted rates used in the calculations. It was however insensitive to subsidy withdrawal on cocoa fertilizers and producer price stabilization at the rates used. The "CODAPEC" programme, on the other hand is also insensitive to price stabilization in future producer price. Therefore the two programmes are profitable, viable and sustainable at different rates of discount and support one another.

# CHAPTER FIVE

## CONCLUSIONS

This chaptersummaries the major findings of the research and draws conclusions from the results of the study. Some policy recommendations based on the findings and major limitations to the study are made.

### 5.1 Summary of Findings

The descriptive data revealed that cocoa farming in Ghana is male dominated due to its labour intensive nature. About 80% of the farmers interviewed were males and 87% of the farmers in the cocoa sector were less educated a factor that shouldbe considered in the packaging and transfer of technological innovations.

The repayment of credit facilities by the "HI-TECH" farmers was encouragingand evidence from the studyindicatedover 80% loan recoveryat the time of the survey. The cocoa mass spraying ("CODAPEC") and the fertilizer use programme ("HI-TECH")have raised the national yieldfrom 0.35tons per hectare to 0.667tons and 1.679tons per hectare, representingan increase of 93.7% and 386% respectively. The study also showed an average rate of return on investment (ROI) of 1.29 and 2.05 for "CODAPEC" and "HI-TECH" farmers respectively.This confirmed that an increase of 0.366mt per ha and 1.358mt per ha respectively could be attributed to the adoption of the mass spraying (CODAPEC) and the fertilizer use (HI-TECH) programmes.The empirical results revealed that both programmes made some gains but the fertilizer use in cocoa production ("HI-TECH") programmewas highly sustainable, financially viable and profitable and alsoprovided sufficient incentive for the continuity of the programmeandsustenanceof the cocoa industry.The empirical findings were further confirmed as the results of the sensitivity analysis for the "HI-TECH" and "CODAPEC" programmes revealedthat at stable cocoa producer price for a decade the financialinternal rate of return (FIRR) of105.29% and 84.66% were respectively recorded. Even when subsidy on fertilizer was set aside the "HI-TECH" programme was still profitable and viable at 55% and 85% discounted rates with an internal rate of return of 94.59%.

## 5.2 Policy Recommendation

Based on the findings from the study, the following recommendations are made to shape future policy directionon the "CODAPEC" and "HI-TECH" programmes in Ghana:.

1. "CCODAPEC" programme has shown a tremendous increase in cocoa production over the years under review and it is recommended that Government of Ghana (GoG) continues the "CODAPEC" programme (Cocoa mass spraying policy) annually.
2. The "HI-TECH" has increased productivity to an appreciable level,it is recommended to policy makers to subsidize cocoa fertilizer and other agrochemicals used in cocoa production to entice larger majority of Ghanaian cocoa farmers to adopt fertilizer applicationas a component of cocoa farming activity to increase output to raise the national output to increase the country's foreign exchange earnings.

## 5.3 Limitations of the Study and Suggestions for Future Research

Due to the privatization of the internal marketing of cocoa, farmers do not only sell their dried cocoa beans to the Produce Buying Company but to other companies like Cashew and Spices Products Ltd., Kuapa Kokoo Ltd., Adwumapa Buyers Ltd., Akuafo Adamfo Marketing Company Ltd., etc. and gathering output data from such numerous buying companies on a single farmer especially between 1998 and 2006 became quite challenging. Therefore such situations required time and circumspection.

Aside the above constraint cocoa farmers did not keep records on their day to day and annual activities (especially on minor expenses) and as such most activity records were based on extrapolations from current existing costs. The only record available to the farmer is the cocoa passbook in which output records are kept.

Constraints of time and finance could not entirely be ruled out, and it is for such reasons that the research study area was limited to only three districts in three regions of the six cocoa regions in the country.

Though these constraints were encountered during the period of study, they did not affect the results of the study. It is therefore suggested that, further studies could be carried out in future in the other areas of the country**.**

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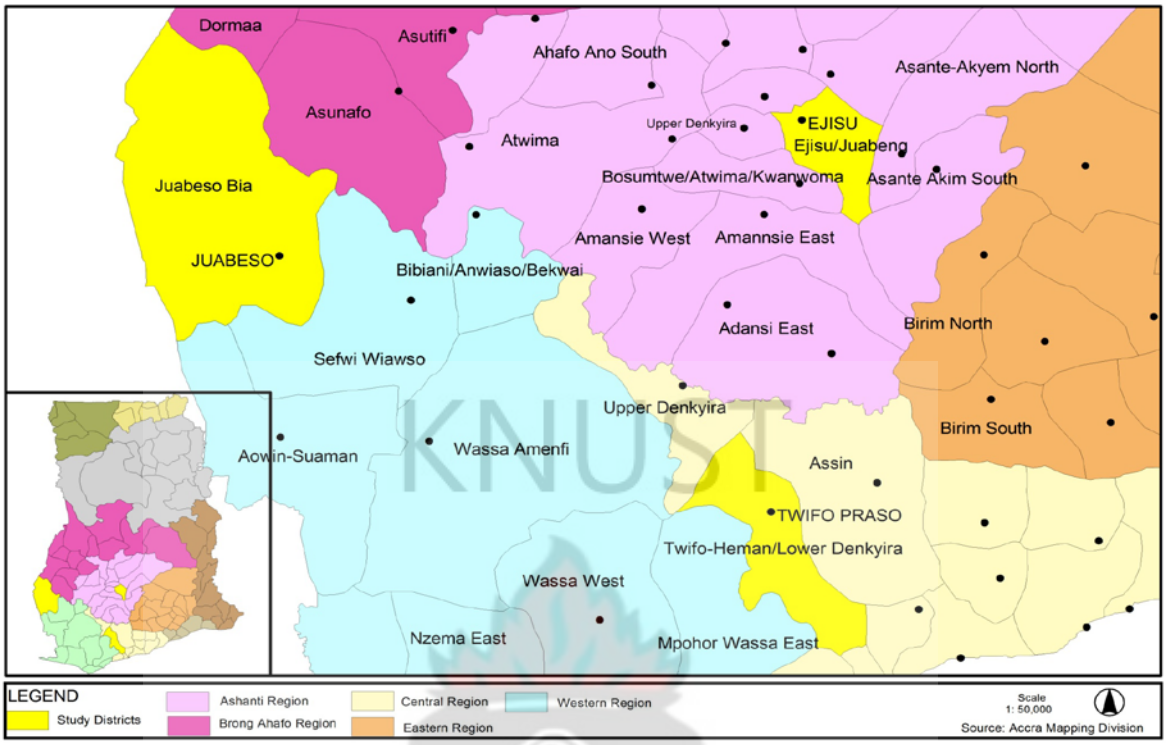
**APPENDICES**

Appendix A1: MAP OF GHANA SHOWING THE STUDY DISTRICTS




**Appendix A2: QUESTIONNAIRES**

**Questionnaire for MOFA Desk Officers and Stakeholders' on the "CODAPEC" Programme.**

1. District…… Region……..
2. How many cocoa villages with spraying gangs are in the district?
3. How many spraying gangs are there in the district……
4. How many members form a spraying gang? .....
5. Records on Supply of Spraying Machines from 2000/01 to 2005/06

| No. of supply | Unit Cost | Total Cost | T&T and Other charges |
|---|---|---|---|

6. How much do you pay each gang member? a. Gang membership record
   b. Gang leaders **c.** Record of Mechanics 2000/01-2005/06

| Year | Membership | Monthly wage/head | Total wage |
|---|---|---|---|

7. Supply of Spare parts for maintaining the machines
   a. What are the parts supplies for the maintenance of the machines?
8. How much in money terms is the supply annually
9. Supervisors and Allowance -2000/01-2005/06

| Year | No. of Supervisor | Allowance/month/head | Total allowance |
|---|---|---|---|

10. What other oversight committees on hi-tech and "CODAPEC" are available in the district?
11. Do they receive any remuneration? Yes [ ] No [ ]
12. If yes fill in the table below
12. Name of Committee and their allowances
13. Records on chemical supply
14. Records on chemical supply to Gangs

Size of the Mist blower tank……Litres……

15 Transportation and handling charges on chemical supply-2000/1 – 2005/06

16. Fuel Allocation to the district-2000/1 – 2005/06

| Year | Total allocation | Rate/litre | T&T Handling | Total Cost |
|---|---|---|---|---|
| | | | | |

17. Fuel Allocation to Gangs in Operational Areas.

18 Allowance for the following categories of staff on Hi-tech at MoFA's officer rate/ month-Director. Desk officer and store-keeper

19. How many months are the "CODAPEC" working teams paid remuneration in a year?

20. Chemical usage and Dosage

21. Records on Protective clothing Supplied as a component of the "CODAPEC" programme. a. Records of uniform (overall), b. Hats/ Caps **c.** Wellington boots d. Goggles e. Respirators f. Hand grooves supplied since the "CODAPEC" started eg

| Year | Total Quantity | Unit Charge | Total Cost |
|---|---|---|---|
| 2000/01 to 2005/06 | | | |

22. How do you see the future of "CODAPEC?"

23 What is government's contribution to the "CODAPEC" programme?

24. What roles does your outfit (MOFA) play in the "CODAPEC" programme?

25. How many acres of cocoa farm does each sprayer spray each day?

26. What are the farmers' contributions toward the spraying programme?

27 General comments on the "CODAPEC" programme

**Questionnaire for MOFA Desk Officers and Stakeholders' on the "Hi-Tech" Programme**

1 District…… Region……..

**2** How many cocoa villages received the Hi-Tech fertilizers?.....

**3** How many farmers in each cocoa village received the supplied fertilizer?

4 Records on Fertilizer supply in the District.

| Year | No. of supply | Unit Cost | T&T and Other charges | Total Cost |
|---|---|---|---|---|
| | | | | |

5. Fertilizer supply per cocoa farmer per year?

Fertilizer supply to Farmers-2000/01 to 2005/06

| Year | Total No. of Farmer | Fertilizer per Farmer | Fertilizers per acre |
|---|---|---|---|
| | | | |

**6.** Insecticide allocation in the district for Hi-tech farmers only. 2000/01 to 2005/06-

| Year | Name of Insecticide | No. of supply(cartons) | Unit Cost | T&T and Other charges | Total Cost |
|---|---|---|---|---|---|
| | | | | | |

7. Insecticide supplied in addition to the fertilizer (Hi-tech-tech)

Insecticides Allocation to Hi-tech farmers.- 2000/01 to 2005/06

| Year | Name of Insecticide | Total quantity supply | Quantity per farmer/acreage | Unit Price |
|---|---|---|---|---|
| | | | | |

**8.** Fungicide allocation in the district for Hi-tech farmers only.

**9.** Fungicide supplied in addition to the fertilizer (Hi-tech-tech) Fungicide Allocation to Hi-tech Farmers.

**10.** Supervisors and Allowance

**11.** Fuel Allocation to the Hi-tech farmers in the district-2000/01-2005/06

| Year | Total allocation | Rate/litre | T&T& Handling | Total Cost |
|---|---|---|---|---|
| | | | | |

17. Apart from the fertilizer, insecticide and the fungicide what other cocoa inputs are supplied to the hi-tech farmers?

18. Are farmers given credit of cash in addition the inputs mentioned above?

19. If Yes fill in the table below for total number of farmers giving such support?

| Year | Total farmers | Amount /Farmer | Interest rate | Total Amount | Balance Remained |
|---|---|---|---|---|---|

20. How many months are the "**Hi-tech**" working teams paid remuneration/allowance in a year?
21. How do you see the future of Hi-tech……
22. What is government's contribution to the "Hi-Tech" programme? ….
23. What roles does your outfit (MOFA) play in the "Hi-Tech" programme?
24. Any comments?

**Questionnaire for "CODAPEC' Participants (Farmers)**

***Personal Information***

Respondent's Serial No. [ ] Date / / 06

Region …..…District: ……..Town/Village:…..…

1. Name of Cocoa farmer…
2. Sex [ M ] [ F ]
4. Date of Birth/Age……19……
4. Marital Status 1. Single [ ] 2. Married [ ] 3. Separated [ ]
   4. Divorced [ ] 5. Widowed [ ]
5. Education Status 1. Illiterate / Basic [ ] 2. Secondary [ ] 3. Tertiary [ ]
6. Are you a family head: Yes [ ] No [ ]
7. Family size…….
8. No. of dependents […….]
   a Adult [ ] b. School aged children [ ] c. Children below 6 years [ ]
9. No. of family members who are engaged regularly in the cocoa farm

Cocoa Farm Information (Hi-Tech)

10. How many acres of cocoa farm do you own? ……
11. Are you adopting the Hi-tech technology? Yes [ ] No [ ]
12. Have ever use fertilizer in your cocoa farming ever? Yes [ ] No [ ]
13 Why don't you use fertilizer in your cocoa farming activities
14. Have you ever benefited from the mass spraying Programme? Yes [ ] No [ ]
15. If yes how many times is your farm sprayed in a year
16. Who pays for the fuel (Mass spraying) use on your farm? ....
17. Under the mass spraying who bears the following **spraying cost?**
    a. Chemical b. spraying itself c. Water fetching d. Loading and off-loading the spraying machine e Feeding f. Others (specify
18. Cost of spraying activities (Mass Spraying/ "CODAPEC")- 2000/01 to 2005/06

| Year | Type /Name of Chemical | Cost of Chemical | Quantity (Fills or Lts) | Sprayer Charge | Cost of water fetching | Feeding/loading /other charges |
|---|---|---|---|---|---|---|

19. Apart from the mass spraying exercise, do you spray the farm at your own cost?
    Yes [ ] No. [ ]
20. If yes how many times in a year……..
21. Cost of spraying activity done by farmer- 2000/01 to 2005/06
22. Where do you get your chemicals from?
23. Which of the following implements and machines do you have and use in your farming activities. a. Mist blower b. Knapsack c. Pruner d. Drying Mat

e. baskets f. Others (specify)

24. Cost of implements and machine eg Mist blower, Knapsack, Drying Mat etc

*NB: Cost should include transportation and handling charges*

25. Do you spray against black pod diseases Yes [ ] No. [ ]
26. How many times in a year?.....
27. Type of fungicide use and cost.-2000/01-2005/06
28 How many times do you weed your farm in a year?
29 Cost of Labour requirement on pruning (Mistletoe removal) in a year?
30. Cost of Labour requirement on Harvesting
31. How much does it cost you averagely for breaking of harvested pod?
32. How do you get you fermented cocoa beans to the drying mat?
Hired labour [ ] Family [ ]
33. How much do you pay for conveying fermented beans to the house annually**?**
34. Do you pay for someone to dry the cocoa for you? Yes [ ] No [ ]
35. If yes, what is the average charge for drying a bag of cocoa? ¢.....
36 Yield Records of farmer: - Before and After Adoption of the Programmes

| Before Adoption CODAPEC | | | After Adoption CODAPEC | | |
|---|---|---|---|---|---|
| YEAR | Output | Total Income | | Output | Total Income |
| 1994/95 to | | | 2000/01 to | | |
| 1999/200 | | | 2005/06 | | |

37. Indicate the number of the following items you purchase in a year and their respective quantities and cost- cutlass, go-to-hell, dry mat, uniform etc
38. Do you accept that the introduction of the "Hi-tech" and the "Codapec" programmes have improved your output? Yes [ ] No [ ]
39. If yes, what is the rate of increase in yield?

| Year | No. of Bags | Rate of Increase/acre in bags |
|---|---|---|
| 2000/01 to 2005/06 | | |

40. Will you say that the programme is profitable? Yes [ ] No. [ ]
41. If yes, were you able to pay for all expense on the programme and still make some profit? Yes [ ] No. [ ]
42. Assuming if government withdraws her services as far as the mass spraying programme is concerned, will you still continue the hi-tech programme?
43. Assuming if fertilizer is not credited, will you still continue the hi-tech programme? Yes [ ] No [ ]
44. Please give explanation on how you will manage on your own for questions 42 and 43
45. What benefits do you get from the Extension Services (MoFA) as far as this programme is concerned?
46. Do the extension service contribute to your achievement in the cocoa "COAPEC" programmes? Yes [ ] No [ ]
47. Explain your answer.
48. Who pays for the extension service activities in the cocoa Hi-tech and "COAPEC" programmes?
49. Any comment about the "HI-TECH" and "CODAPEC" programmes?

**Questionnaire for "Hi-Tech" Participants (Farmers)**

***Personal Information***

Respondent's Serial No. [ ] Date / / 06

Region:……District:……Town/Village:……..1.

1. Name of Cocoa farmer 2. Sex
3. Date of Birth/Age……19……
4. Marital Status
   1. Single [ ] 2. Married [ ] 3. Widowed [ ] 4. Separated [ ]
   5. Divorced
5. . Education Status

1. Illiterate / Basic [ ] 2. Secondary [ ] 3. Tertiary [ ]

6. Are you a family head: Yes [ ] No [ ]
7. Family size…….
8. No. of dependents [….] a Adult [ ] b. School aged children [ ]
   c. Children. below 6 years [ ]
9. No. of family members who are engaged regularly in the cocoa farm

***Cocoa Farm Information (Hi-Tech)***

10. How many acres of cocoa farm do you own? ……
11. Are you adopting the Hi-tech technology? Yes [ ] No [ ]
12. If yes since when and how many acres of your cocoa farm are under the Hi-technology (1) …… (2) ……
13 How many bags of fertilizers do you apply to acre of cocoa farm
14. Complete the table on fertilizer usage? (Fertilizer use and Cost)-2000/01-2005/06

| Year | No. of Bags Use | Cost/bag | Transport & Handling charges | Application cost (Labour) | Other Charges |
|---|---|---|---|---|---|
| | | | | | |

15. Is the fertilizer given on credit Yes [ ] No [ ]
16. If yes what is the interest rate on the fertilizer inputs. …….
17. Were you able to pay for the fertilizer cost on time? Yes [ ] No [ ]
18. If the answer is No, why? ……..
19. Have you ever benefited from the mass spraying Programme? Yes [ ] No [ ]
20. If yes how many times is your farm sprayed in a year……
21. Who pays for the fuel (Mass spraying) use on your farm? .....
22. Under the mass spraying who bears the following spraying cost?
    a. Chemical b. Spraying itself c. Water fetching d. Loading and off-loaning the spraying machine e Feeding f. Others (specify)
23. Cost of spraying activities (Mass Spraying/ "CODAPEC")
24. Apart from the mass spraying exercise, do you spray the farm at your own cost?
25. If yes how many times in a year
26. Cost of spraying activity done by farmer.
27. Where do you get your chemicals from?
28. Which of the following implements and machines do you have and use in your farming activities. a. Mist blower, b. Knapsack c. Pruner, d. Drying Mat, and e. Baskets f. Bowl, g. Others (specify) (
29. Where do you buy your fertilizers from?
30. Cost of these implements and machines used and their lifespan., pruner etc

*NB: Cost should include transportation and handling charges*

31. Do you spray against black pod diseases Yes [ ] No. [ ]

32. How many times in a year?
33. Type of fungicide use and cost. From2000/01 – 2005/06
34. How many times do you weed your farm in a year?
35. Cost of Labour requirement on pruning (Mistletoe removal) in a year?
36. Cost of Labour requirement on Harvesting
37. How much does it cost you averagely for breaking of harvested pod?
38. How do you get you fermented cocoa beans to the drying mat?
Hired labour [ ] Family [ ]
39. How much do you pay for conveying fermented beans to the house annually?
40. Do you pay for someone to dry the cocoa for you? Yes [ ] No [ ]
41. If yes, what is the average charge for drying a bag of cocoa? ¢.....
42 Yield Records of farmer: - Before and After Adoption of the Programmes

| Before Adoption Hi-tech/ CODAPEC | | | After Adoption Hi-tech/ CODAPEC | | |
|---|---|---|---|---|---|
| YEAR | Output | Total Income | | Output | Total Income |
| 1998/99 to | | | 2000/01 to | | |
| 1999/200 | | | 2005/06 | | |

43. Indicate the number of the following items you purchase in a year and their respective cost eg cutlass, go-to-hell, farm uniform, wellington boot, baskets etc
44. Do you accept that the introduction of the "Hi-tech" and the "CODAPEC" programmes have improved your output? Yes [ ] No [ ]
45. If yes, what is the rate of increase in yield?-2000/01-2005/06

| Year | No. of Bags | Rate of Increase/acre in bags |
|---|---|---|

46. Will you say that the programme is profitable? Yes [ ] No. [ ]
47. If yes, were you able to pay for all expense on the programme and still make some profit? Yes [ ] No. [ ] Breakeven [ ]
48 Assuming if government withdraws her services as far as the mass spraying programme is concerned; will you still continue the hi-tech programme?
49. Assuming if fertilizer is not credited, will you still continue the hi-tech programme? Yes [ ] No [ ]
50. Please give explanation on how you will manage on your own for questions 48 and 49
51. What benefits do you get from the Extension Services (MoFA) as far as this programme is concerned?
52. Do the extension service contribute to your achievement in the cocoa "HI-TECH" programme? Yes [ ] No [ ]
53. Explain your answer
54. Who pays for the extension services/ activities in the cocoa" HI-TECH" programme?
55. Any comments about the Hi-tech and CODAPEC programmes

Appendix 3: Trends in Cocoa Production (Mt) and Producer Price -1960 2006

| CROP YEAR | Producer Price of Cocoa | % Change in Price | Annual Output of Cocoa | % Change in Output |
|---|---|---|---|---|
| 1960/61 | 264 | 0 | 437304 | 35.7 |
| 1961/62 | 264 | 0 | 415,961 | -4.88 |
| 1962/63 | 264 | 0 | 428,484 | 3.01 |
| 1963/64 | 264 | 0 | 427,782 | -0.16 |
| 1964/65 | 264 | 0 | 580,869 | 35.79 |
| 1965/66 | 174 | -34.09 | 415,762 | -28.42 |
| 1966/67 | 198 | 13.79 | 318,353 | -23.43 |
| 1967/68 | 238 | 20.2 | 430,665 | 35.28 |
| 1968/69 | 257 | 7.98 | 355,588 | -17.43 |
| 1969/70 | 294 | 14.4 | 417,457 | 17.4 |
| 1970/71 | 294 | 0 | 427,894 | 2.5 |
| 1971/72 | 294 | 0 | 469,863 | 9.81 |
| 1972/73 | 367 | 24.83 | 421,767 | -10.24 |
| 1973/74 | 441 | 20.16 | 354,630 | -15.92 |
| 1974/75 | 551 | 24.94 | 378,759 | 6.8 |
| 1975/76 | 588 | 6.72 | 400,380 | 5.71 |
| 1976/77 | 735 | 25 | 324,111 | -19.05 |
| 1977/78 | 1,333 | 81.36 | 271,339 | -16.28 |
| 1978/79 | 2,667 | 100.08 | 265,074 | -2.31 |
| 1979/80 | 4,000 | 49.98 | 296,419 | 11.82 |
| 1980/81 | 4,000 | 0 | 257,974 | -12.97 |
| 1981/82 | 12,000 | 200 | 224,882 | -12.83 |
| 1982/83 | 12,000 | 0 | 178,626 | -20.57 |
| 1983/84 | 20,000 | 66.67 | 158,530 | -11.25 |
| 1984/85 | 30,000 | 50 | 174,813 | 10.27 |
| 1985/86 | 56,600 | 88.67 | 219,044 | 25.3 |
| 1986/87 | 85,000 | 50.18 | 227,764 | 3.98 |
| 1987/88 | 150,000 | 76.47 | 188,177 | -17.38 |
| 1988/89 | 165,000 | 10 | 300,101 | 59.48 |
| 1989/90 | 174,400 | 5.7 | 295,051 | -1.68 |
| 1990/91 | 244,000 | 39.91 | 293,352 | -0.58 |
| 1991/92 | 251,200 | 2.95 | 242,817 | -17.23 |
| 1992/93 | 258,000 | 2.71 | 312,122 | 28.54 |
| 1993/94 | 308,000 | 19.38 | 254,655 | -18.41 |
| 1994/95 | 700,000 | 127.27 | 309,456 | 21.52 |
| 1995/96 | 840,000 | 20 | 403,842 | 30.5 |
| 1996/97 | 1,200,000 | 42.86 | 322,497 | -20.14 |
| 1997/98 | 1,800,000 | 50 | 409,400 | 26.95 |
| 1998/99 | 2,250,000 | 25 | 397,700 | -2.86 |
| 1999/2000 | 2,250,000 | 0 | 436,600 | 9.78 |
| 2000/01 | 3,475,000 | 54.44 | 389,800 | -10.72 |
| 2001/02 | 5,292,000 | 52.29 | 340,600 | -12.62 |
| 2002/03 | 8,750,000 | 65.34 | 496,800 | 45.86 |
| 2003/04 | 9,000,000 | 2.86 | 736,699 | 48.29 |
| 2004/05 | 9,000,000 | 0 | 599,000 | -18.69 |
| 2005/06 | 9,000,000 | 0 | 741,000 | 23.71 |

Source: Survey Data, 2006

Appendix 4: Output per Ha for "CODAPEC" Farmer- District Level

| YEAR | ASHANTI | CENTRAL | WESTERN | Total | AVERAGE |
|---|---|---|---|---|---|
| | Kg/ha | Kg/ha | Kg/ha | Kg/ha | Kg/ha |
| 1998/99 | 289.7 | 302.8 | 286.6 | 879.1 | 293.03 |
| 1999/00 | 302.7 | 322.7 | 309.7 | 935.1 | 311.70 |
| 2000/01 | 366.6 | 403.7 | 353.2 | 1123.5 | 374.50 |
| 2001/02 | 385.0 | 396.6 | 389.9 | 1171.5 | 390.50 |
| 2002/03 | 435.0 | 469.6 | 447.7 | 1352.3 | 450.77 |
| 2003/04 | 511.2 | 533.8 | 525.8 | 1570.8 | 523.60 |
| 2004/05 | 579.4 | 596.0 | 582.4 | 1757.8 | 585.93 |
| 2005/06 | 655.8 | 710.2 | 667.5 | 2033.5 | 677.83 |

Source: Survey, 2006



Appendix 5: Output per Ha for "HI-TECH" Operators-District Level

| YEAR | ASHANTI | CENTRAL | WESTERN | TOTAL | AVERAGE |
|---|---|---|---|---|---|
| | Kg/ha | Kg/ha | Kg/ha | Kg/ha | Kg/ha |
| 1998/99 | 306.10 | 319.60 | 309.30 | 935.00 | 311.67 |
| 1999/00 | 314.60 | 330.80 | 318.10 | 963.50 | 321.17 |
| 2000/01 | 832.20 | 862.70 | 843.80 | 2,538.70 | 846.23 |
| 2001/02 | 845.00 | 1,141.40 | 904.60 | 2,891.00 | 963.67 |
| 2002/03 | 985.20 | 1,239.00 | 1,001.80 | 3,226.00 | 1,075.33 |
| 2003/04 | 1,143.40 | 1,412.00 | 1,156.00 | 3,711.40 | 1,237.13 |
| 2004/05 | 1,376.40 | 1,651.20 | 1,321.80 | 4,349.40 | 1,449.80 |
| 2005/06 | 1,600.70 | 1,888.60 | 1,548.70 | 5,038.00 | 1,679.33 |

Source: Survey, 2006

Appendix 6: MEAN YIELD AND REVENUE PER ANNUM PER HECTARE

| | Yield/Ha | | Price /kg | Revenue / Ha | |
|---|---|---|---|---|---|
| YEAR | CODAPEC | HI-TECH | | CODAPEC | HI-TECH |
| | GH ¢ | | GH ¢ | GH ¢ | |
| 1998/99 | 293.03 | 311.67 | 0.225 | 65.93 | 70.13 |
| 1999/00 | 311.7 | 321.17 | 0.225 | 70.13 | 72.26 |
| 2000/01 | 374.5 | 846.23 | 0.348 | 130.14 | 294.06 |
| 2001/02 | 390.5 | 963.67 | 0.620 | 242.11 | 597.48 |
| 2002/03 | 450.77 | 1,075.33 | 0.850 | 383.15 | 914.03 |
| 2003/04 | 523.6 | 1,237.13 | 0.900 | 471.24 | 1,113.42 |
| 2004/05 | 585.93 | 1,449.80 | 0.900 | 527.34 | 1,304.82 |
| 2005/06 | 677.83 | 1,679.33 | 0.900 | 610.05 | 1,511.40 |

Source: Survey Data, 2006

Appendix 7: Calculations for Yield/ha and Revenue/ha for CODAPEC Programme:-

1998/99-2005/06 -District Level Data

| YEAR | ASHANTI | | CENTRAL | | WESTERN | |
|---|---|---|---|---|---|---|
| | Yield | Revenue GH¢ | Yield | Revenue GH¢ | Yield | Revenue GH¢ |
| 1998/99 | 289.7 | 65.18 | 302.8 | 68.13 | 286.6 | 64.49 |
| 1999/00 | 302.7 | 68.11 | 322.7 | 72.61 | 309.7 | 69.68 |
| 2000/01 | 366.6 | 127.39 | 403.7 | 140.29 | 353.2 | 122.74 |
| 2001/02 | 385 | 238.70 | 396.6 | 245.89 | 389.9 | 241.74 |
| 2002/03 | 435 | 369.75 | 469.6 | 399.16 | 447.7 | 380.55 |
| 2003/04 | 511.2 | 460.08 | 533.8 | 480.42 | 525.8 | 473.22 |
| 2004/05 | 579.4 | 521.46 | 596 | 536.40 | 582.4 | 524.16 |
| 2005/06 | 655.8 | 590.22 | 710.2 | 639.18 | 667.5 | 600.75 |

Source: Survey Data, 2006

Appendix 8 Calculations for Yield/ha and Revenue/ha for Hi-tech Programme:-

1998/99-2005/06 -District Level Data

| | ASHANTI | | CENTRAL | | WESTERN | |
|---|---|---|---|---|---|---|
| YEAR | Yield /ha (kgs) | Revenue GH¢ | Yield/ha (Kgs) | Revenue /ha GH¢ | Yield/ha Kgs | Revenue /ha GH ¢ |
| 1998/99 | 306.1 | 69.32 | 319.6 | 74.39 | 309.3 | 69.32 |
| 1999/00 | 314.6 | 79.79 | 330.8 | 92.43 | 318.1 | 91.31 |
| 2000/01 | 832.2 | 278.42 | 862.7 | 284.50 | 843.8 | 288.01 |
| 2001/02 | 845 | 527.44 | 1,141.40 | 707.67 | 904.6 | 560.85 |
| 2002/03 | 985.2 | 804.27 | 1,239.00 | 1,002.15 | 1,001.80 | 824.33 |
| 2003/04 | 1,143.40 | 1,029.06 | 1,412.00 | 1,.270.00 | 1,156.00 | 1,040.40 |
| 2004/05 | 1,376.40 | 1,233.36 | 1,651.20 | 1,483.30 | 1,321.80 | 1,181.52 |
| 2005/06 | 1,600.70 | 1,392.93 | 1,888.60 | 1,654.74 | 1,548.70 | 1,328.13 |

Source: Survey Data, 2006

Appendix 9 Farmers' Costs and Returns per hectare under "CODAPEC" Programme (GH¢)

| Description | 1998/99 | 1999100 | 2000/01 | 2001/02 | 2002/03 | 2003/04 | 2004/05 | 2005/06 |
|---|---|---|---|---|---|---|---|---|
| **Mass Spraying** | | | | | | | | |
| Farmer's contribution | | | 1.13 | 1.23 | 1.60 | 1.77 | 1.87 | 2.23 |
| Gov't's contribution | | | 5.43 | 7.00 | 8.00 | 9.67 | 11.83 | 12.50 |
| **Farmers' own Activities** | | | | | | | | |
| Insecticides | 4.07 | 4.70 | 4.32 | 6.29 | 10.88 | 11.54 | 14.03 | 13.07 |
| Fungicides | 2.33 | 2.53 | 2.49 | 2.95 | 4.38 | 4.38 | 5.30 | 6.80 |
| Weeding/ha | 6.50 | 7.50 | 12.17 | 14.17 | 17.00 | 20.50 | 24.00 | 27.67 |
| Pruning | | | 26.07 | 22.67 | 20.17 | 18.00 | 16.67 | 16.67 |
| Harvesting | 6.50 | 6.50 | 10.00 | 12.93 | 14.23 | 16.37 | 18.33 | 21.33 |
| Pod breaking | 6.20 | 7.10 | 10.03 | 12.47 | 13.27 | 14.93 | 16.97 | 18.53 |
| Conveyance | 6.03 | 7.10 | 9.07 | 12.17 | 14.33 | 16.50 | 18.47 | 21.30 |
| Dry cost | 5.47 | 6.20 | 8.13 | 10.00 | 12.17 | 13.80 | 15.53 | 18.00 |
| Marketing | 5.27 | 6.67 | 7.07 | 11.07 | 12.47 | 14.93 | 16.97 | 19.13 |
| Fixed input | 7.67 | 8.57 | 10.03 | 13.37 | 14.73 | 17.17 | 19.00 | 23.00 |
| Mgt cost/ha | 7.77 | 8.73 | 10.73 | 12.67 | 13.60 | 15.37 | 17.13 | 20.67 |
| Total cost | 58.70 | 63.50 | 116.67 | 138.97 | 156.82 | 174.92 | 196.10 | 220.90 |
| Total Yield | 293.00 | 311.70 | 374.50 | 390.50 | 450.8 | 523.60 | 585.90 | 677.8 |
| Price/kg | 0.225 | 0.225 | 0.35 | 0.62 | 0.85 | 0.9 | 0.90 | 0.90 |
| Total Revenue | 65.93 | 70.13 | 130.14 | 242.11 | 383.18 | 471.24 | 527.31 | 610.02 |
| **Net Return** | 8.13 | 6.63 | 13.47 | 103.14 | 226.36 | 296.32 | 331.21 | 389.12 |

Source: Survey Data 2006

Appendix 10: Farmers' Costs and Returns under "Hi-tech" Programme (GH¢)

| Description | 1998/99 | 1999/00 | 2000/01 | 2001/02 | 2002/03 | 2003/04 | 2004/05 | 2005/06 |
|---|---|---|---|---|---|---|---|---|
| **Mass spraying** | | | | | | | | |
| Farmer contribution | | | 2.30 | 2.67 | 3.33 | 3.73 | 4.23 | 4.50 |
| Gov't contribution | | | 7.53 | 9.10 | 12.70 | 14.73 | 16.93 | 19.07 |
| Fertilizer cost | | | 119.97 | 146.50 | 167.35 | 178.47 | 187.33 | 196.75 |
| **Farmers' own Activities** | | | | | | | | |
| Insecticides | 3.10 | 3.60 | 7.00 | 13.43 | 15.57 | 18.30 | 20.43 | 21.90 |
| Fungicide | 3.85 | 3.85 | 4.27 | 5.50 | 6.73 | 7.80 | 8.60 | 9.57 |
| Weeding | 6.50 | 7.50 | 15.00 | 18.07 | 20.60 | 24.83 | 29.60 | 34.67 |
| Pruning | - | - | 28.67 | 24.33 | 22.03 | 19.33 | 17.67 | 17.67 |
| Harvesting | 6.13 | 6.50 | 10.03 | 11.20 | 14.80 | 19.17 | 21.67 | 26.17 |
| Pod breaking | 6.20 | 7.10 | 10.07 | 13.03 | 17.07 | 20.37 | 23.07 | 24.63 |
| Conveying | 6.53 | 7.63 | 9.23 | 12.33 | 16.23 | 19.27 | 22.70 | 25.83 |
| Drying | 6.20 | 6.20 | 8.67 | 9.10 | 11.90 | 14.80 | 17.83 | 21.23 |
| Marketing | 4.47 | 5.10 | 7.50 | 9.40 | 12.57 | 15.37 | 18.63 | 21.87 |
| Management | 7.03 | 7.30 | 10.47 | 15.10 | 17.50 | 20.50 | 24.30 | 31.03 |
| Fixed Input | 8.53 | 9.00 | 14.30 | 19.87 | 24.07 | 27.13 | 28.67 | 29.10 |
| Total cost | 58.22 | 63.78 | 244.97 | 309.63 | 362.45 | 403.80 | 441.67 | 483.99 |
| Total yield/ha | 311.67 | 321.17 | 846.23 | 963.67 | 1,075.33 | 1,237.13 | 1,449.80 | 1,679.33 |
| Price/kg | 0.225 | 0.225 | 0.3475 | 0.62 | 0.85 | 0.90 | 0.90 | 0.90 |
| Total Revenue | 70.13 | 72.26 | 294.06 | 597.48 | 914.03 | 1,113.42 | 1,304.82 | 1,511.40 |
| **Net Return** | 11.91 | 8.48 | 49.10 | 2,878.14 | 551.58 | 709.62 | 863.15 | 1,030.41 |

Source: Survey Data 2006

Appendix 11: “HI-TECH" FINANCIAL ANALYSIS (per hectare) - Cash flow

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **REVENUE:** | | | | | | | | | | | | | | | | | | | | |
| Added Yield (kg) | 525.06 | 642.50 | 754.16 | 915.96 | 1,128.16 | 1,358.16 | 1,378.53 | 1,399.21 | 1,420.20 | 1,427.30 | 1,448.71 | 1,470.44 | 1,492.50 | 1,514.88 | 1,552.76 | 1,591.57 | 1,631.36 | 1,672.15 | 1,713.95 | 1,756.80 |
| Price /kg | 0.35 | 0.62 | 0.85 | 0.90 | 0.90 | 0.90 | 1.09 | 1.32 | 1.59 | 1.93 | 2.35 | 2.87 | 3.50 | 3.86 | 4.25 | 4.69 | 5.17 | 5.69 | 6.27 | 6.91 |
| Total Revenue | 183.77 | 398.35 | 641.04 | 824.36 | 1,015.34 | 1,222.34 | 1,501.22 | 1,843.73 | 2,264.37 | 2,753.59 | 3,409.77 | 4,222.32 | 5,228.50 | 5,848.23 | 6,605.87 | 7,461.66 | 8,428.31 | 9,520.20 | 10,753.55 | 12,146.67 |
| | 118.56 | 165.81 | 172.14 | 142.82 | 113.49 | 88.15 | 69.84 | 55.34 | 43.85 | 34.40 | 27.48 | 21.96 | 17.54 | 12.66 | 9.22 | 6.72 | 4.90 | 3.57 | 2.60 | 1.90 |
| **COST:** | | | | | | | | | | | | | | | | | | | | |
| Mass Spraying | | | | | | | | | | | | | | | | | | | | |
| Gov’t contrib. | 7.50 | 9.10 | 12.70 | 14.73 | 16.93 | 19.07 | 23.84 | 29.80 | 37.25 | 46.56 | 58.20 | 72.75 | 90.93 | 113.67 | 130.72 | 150.32 | 187.90 | 234.88 | 293.60 | 367.00 |
| Farmer contrib. | 2.30 | 2.67 | 3.33 | 3.73 | 4.23 | 4.50 | 6.08 | 8.20 | 11.07 | 14.95 | 20.18 | 27.24 | 36.77 | 49.65 | 67.02 | 83.78 | 104.72 | 130.90 | 163.63 | 204.53 |
| Fertilizer | 119.97 | 146.50 | 167.35 | 178.43 | 187.33 | 196.75 | 218.39 | 242.42 | 269.08 | 298.68 | 327.05 | 358.13 | 392.15 | 421.56 | 453.17 | 487.16 | 523.70 | 562.98 | 605.20 | 614.28 |
| Insecticides | 3.40 | 9.83 | 11.97 | 14.70 | 18.33 | 18.30 | 27.45 | 30.20 | 33.21 | 36.54 | 40.19 | 44.21 | 50.84 | 58.47 | 67.24 | 77.32 | 88.92 | 102.26 | 117.60 | 135.23 |
| Fungicide | 1.42 | 1.65 | 2.88 | 3.95 | 4.75 | 5.72 | 14.30 | 18.88 | 24.92 | 32.89 | 43.41 | 57.31 | 64.47 | 72.21 | 80.87 | 90.58 | 101.44 | 113.62 | 127.25 | 142.52 |
| Weeding | 7.50 | 10.57 | 13.10 | 17.33 | 22.10 | 27.10 | 54.20 | 81.30 | 121.95 | 182.93 | 274.39 | 305.94 | 341.13 | 380.35 | 424.10 | 472.87 | 527.25 | 587.88 | 655.49 | 730.87 |
| Pruning | 28.67 | 24.33 | 22.03 | 19.33 | 17.67 | 17.67 | 19.79 | 22.17 | 25.49 | 39.25 | 60.45 | 93.10 | 116.37 | 133.83 | 167.28 | 209.10 | 219.56 | 230.54 | 242.06 | 254.17 |
| Harvesting | 3.53 | 4.70 | 8.30 | 9..67 | 15.17 | 19.67 | 29.51 | 41.31 | 57.83 | 80.96 | 113.35 | 141.68 | 177.10 | 221.38 | 276.72 | 332.07 | 381.88 | 439.16 | 505.04 | 580.79 |
| Pod breaking | 2.97 | 5.93 | 9.97 | 13.27 | 15.97 | 17.53 | 26.30 | 39.44 | 59.16 | 88.75 | 133.12 | 199.68 | 220.14 | 242.71 | 267.59 | 295.01 | 324.66 | 357.29 | 393.20 | 432.72 |
| Conveying | 3.50 | 4.70 | 9.70 | 11.63 | 15.07 | 18.20 | 25.48 | 35.67 | 49.94 | 57.43 | 71.79 | 82.56 | 103.20 | 129.00 | 161.25 | 201.56 | 231.79 | 266.56 | 306.55 | 352.53 |
| Drying | 2.47 | 2.90 | 5.70 | 8.61 | 11.63 | 15.03 | 21.04 | 29.46 | 41.24 | 57.74 | 80.83 | 113.17 | 158.44 | 198.05 | 247.56 | 309.45 | 335.75 | 364.29 | 395.25 | 428.85 |
| Marketing | 2.40 | 4.30 | 7.47 | 12.67 | 13.53 | 16.77 | 26.83 | 42.93 | 68.69 | 109.90 | 153.87 | 215.41 | 301.58 | 376.97 | 414.67 | 456.13 | 481.22 | 507.69 | 535.61 | 565.07 |
| Fixed Input | 5.30 | 10.87 | 15.07 | 18.13 | 19.67 | 20.10 | 35.18 | 61.56 | 107.72 | 188.52 | 329.90 | 577.33 | 721.66 | 739.70 | 832.17 | 852.97 | 874.30 | 896.15 | 918.56 | 941.52 |
| Management | 2.17 | 7.80 | 10.20 | 13.20 | 17.00 | 23.73 | 35.60 | 53.39 | 80.09 | 120.13 | 180.20 | 270.30 | 364.90 | 456.13 | 570.16 | 641.43 | 721.61 | 739.65 | 758.14 | 777.10 |
| Total Cost | 193.10 | 245.85 | 299.77 | 329.71 | 379.38 | 420.14 | 563.97 | 736.71 | 987.65 | 1,355.22 | 1,886.93 | 2,558.80 | 3,139.69 | 3,593.66 | 4,160.51 | 4,659.76 | 5,104.71 | 5,533.85 | 6,017.17 | 6,527.18 |
| NCF | (9.33) | 152.50 | 341.27 | 494.65 | 635.96 | 802.20 | 937.25 | 1,107.02 | 1,276.72 | 1,398.37 | 1,522.84 | 1,663.52 | 2,088.81 | 2,254.57 | 2,445.36 | 2,801.90 | 3,323.60 | 3,986.35 | 4,736.37 | 5,619.49 |
| DF@ 55% | 0.645 | 0.416 | 0.269 | 0.173 | 0.112 | 0.072 | 0.047 | 0.030 | 0.019 | 0.012 | 0.008 | 0.005 | 0.003 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| PV@ 55% | (6.02) | 63.48 | 91.64 | 85.70 | 71.08 | 57.85 | 43.60 | 33.23 | 24.72 | 17.47 | 12.27 | 8.65 | 7.01 | 4.88 | 3.41 | 2.52 | 1.93 | 1.49 | 1.15 | 0.88 |
| NPV | 526.96 | | | | | | | | | | | | | | | | | | | |
| DF@85% | 0.541 | 0.292 | 0.158 | 0.085 | 0.046 | 0.025 | 0.013 | 0.007 | 0.004 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| PV@ 85% | (5.04) | 44.56 | 53.90 | 42.23 | 29.35 | 20.01 | 12.64 | 8.07 | 5.03 | 2.98 | 1.75 | 1.04 | 0.70 | 0.41 | 0.24 | 0.15 | 0.10 | 0.06 | 0.04 | 0.03 |
| NPV @ 85 | 218.23 | | | | | | | | | | | | | | | | | | | |
| 586.00 | 124.58 | 102.33 | 80.50 | 57.12 | 42.40 | 30.30 | 26.24 | 22.11 | 19.13 | 16.93 | 15.21 | 13.31 | 10.53 | 7.78 | 5.81 | 4.20 | 2.97 | 2.08 | 1.46 | 1.02 |
| 524.11 | 99.34 | 116.39 | 101.24 | 70.38 | 46.85 | 30.49 | 20.24 | 13.44 | 8.92 | 5.86 | 3.92 | 2.63 | 1.76 | 1.06 | 0.65 | 0.40 | 0.24 | 0.15 | 0.09 | 0.06 |
| 305.88 | 104.38 | 71.83 | 47.34 | 28.15 | 17.51 | 10.48 | 7.60 | 5.37 | 3.89 | 2.89 | 2.17 | 1.59 | 1.06 | 0.65 | 0.41 | 0.25 | 0.15 | 0.09 | 0.05 | 0.03 |

Appendix 12: "CODAPEC" FINANCIAL ANALYSIS (per hectare) - Cash flow

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **REVENUE:** | | | | | | | | | | | | | | | | | | | | |
| Added Yield (kg) | 62.80 | 78.80 | 139.10 | 211.70 | 274.20 | 366.1 | 371.59 | 377.17 | 382.82 | 388.57 | 393.23 | 405.02 | 417.18 | 431.78 | 479.27 | 498.44 | 518.38 | 520.45 | 541.27 | 562.92 |
| Price /kg | 0.35 | 0.62 | 0.85 | 0.90 | 0.90 | 0.90 | 1.09 | 1.32 | 1.59 | 1.93 | 2.35 | 2.87 | 3.50 | 3.86 | 4.25 | 4.69 | 5.17 | 5.69 | 6.27 | 6.91 |
| Total Revenue | 21.98 | 48.86 | 118.24 | 190.53 | 246.78 | 329.49 | 404.66 | 496.99 | 610.37 | 749.63 | 925.53 | 1,163.01 | 1,461.44 | 1,666.88 | 2,038.96 | 2,336.81 | 2,678.17 | 2,963.15 | 3,396.01 | 3,892.10 |
| **COST:** | | | | | | | | | | | | | | | | | | | | |
| Mass spraying: | | | | | | | | | | | | | | | | | | | | |
| Gov't contrib. | 5.43 | 7.00 | 8.00 | 9.67 | 11.83 | 12.50 | 14.75 | 17.41 | 20.54 | 24.23 | 28.60 | 36.60 | 46.85 | 59.97 | 76.76 | 98.26 | 115.94 | 136.82 | 161.44 | 190.50 |
| Farmer contib. | 1.13 | 1.23 | 1.60 | 1.77 | 1.87 | 2.23 | 2.72 | 3.48 | 4.46 | 5.71 | 7.30 | 10.08 | 13.91 | 19.19 | 26.49 | 36.55 | 50.44 | 69.61 | 96.06 | 132.56 |
| Insecticide | 1.57 | 2.85 | 6.18 | 6.84 | 8.33 | 9.33 | 11.66 | 14.58 | 18.22 | 22.78 | 28.47 | 35.59 | 44.49 | 55.61 | 69.51 | 83.42 | 100.10 | 120.12 | 144.14 | 172.97 |
| Fungicide | 1.20 | 1.24 | 1.84 | 1.84 | 2.77 | 4.27 | 5.34 | 6.67 | 8.34 | 10.42 | 13.03 | 16.29 | 20.36 | 25.45 | 31.81 | 39.77 | 49.71 | 62.14 | 77.67 | 97.09 |
| Weeding | 4.67 | 6.67 | 9.50 | 13.00 | 16.50 | 20.17 | 27.03 | 36.22 | 48.53 | 65.03 | 87.14 | 108.06 | 133.99 | 166.15 | 186.09 | 208.42 | 233.43 | 261.44 | 292.81 | 327.95 |
| Pruning | 26.07 | 22.67 | 20.17 | 18.00 | 16.67 | 16.67 | 18.34 | 20.17 | 25.21 | 31.52 | 39.40 | 49.24 | 61.56 | 76.95 | 96.18 | 120.23 | 150.28 | 157.80 | 165.69 | 173.97 |
| Harvesting | 3.50 | 6.43 | 7.73 | 9.87 | 11.83 | 13.83 | 18.53 | 23.17 | 28.96 | 36.20 | 45.24 | 56.56 | 70.69 | 88.37 | 110.46 | 148.02 | 198.34 | 265.78 | 356.14 | 477.23 |
| Pod breaking | 2.09 | 5.37 | 6.17 | 7.83 | 9.87 | 11.43 | 17.15 | 25.72 | 38.58 | 57.86 | 86.80 | 130.19 | 195.29 | 214.82 | 236.30 | 249.30 | 263.01 | 277.48 | 292.74 | 308.84 |
| Conveyance | 3.43 | 5.07 | 7.23 | 7.40 | 11.37 | 14.20 | 18.46 | 24.00 | 31.20 | 40.56 | 52.72 | 68.54 | 89.10 | 115.83 | 127.42 | 140.16 | 154.17 | 169.59 | 186.55 | 205.21 |
| Dry cost | 1.93 | 3.80 | 5.97 | 7.60 | 9.33 | 11.80 | 16.76 | 24.46 | 35.72 | 52.15 | 76.13 | 95.17 | 118.96 | 142.75 | 178.44 | 196.28 | 215.91 | 237.50 | 261.25 | 287.38 |
| Fixed input | 3.17 | 5.50 | 6.87 | 9.30 | 11.13 | 15.13 | 22.70 | 34.04 | 51.06 | 76.60 | 114.89 | 172.34 | 215.43 | 269.28 | 323.14 | 355.45 | 391.00 | 430.10 | 470.96 | 510.99 |
| Marketing | 3.80 | 5.80 | 7.20 | 9.67 | 11.70 | 13.87 | 22.19 | 35.51 | 56.81 | 68.17 | 81.81 | 98.17 | 117.80 | 141.37 | 155.50 | 186.60 | 205.26 | 225.79 | 248.37 | 273.20 |
| Management | 2.00 | 3.93 | 4.87 | 8.40 | 10.27 | 11.93 | 14.91 | 21.62 | 31.35 | 45.46 | 65.92 | 95.59 | 138.60 | 200.97 | 251.21 | 314.01 | 351.69 | 393.90 | 441.16 | 494.10 |
| Total Cost | 59.99 | 77.56 | 93.33 | 111.19 | 133.47 | 157.36 | 210.53 | 287.04 | 398.98 | 536.69 | 727.46 | 972.42 | 1,267.04 | 1,576.71 | 1,869.32 | 2,176.46 | 2,479.30 | 2,808.05 | 3,194.99 | 3,652.00 |
| NCF | (38.01) | (28.70) | 24.91 | 79.34 | 113.31 | 172.13 | 194.14 | 209.94 | 211.40 | 212.94 | 198.06 | 190.60 | 194.41 | 90.17 | 169.64 | 160.35 | 198.87 | 155.10 | 201.02 | 240.10 |
| | 38.71 | 32.28 | 25.06 | 19.26 | 14.92 | 11.35 | 9.79 | 8.62 | 7.73 | 6.71 | 5.86 | 5.06 | 4.25 | 3.41 | 2.61 | 1.96 | 1.44 | 1.05 | 0.77 | 0.57 |
| DF@ 55% | 0.645 | 0.416 | 0.269 | 0.173 | 0.112 | 0.072 | 0.047 | 0.030 | 0.019 | 0.012 | 0.008 | 0.005 | 0.003 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| PV@ 55% | (24.52) | (11.95) | 6.69 | 13.75 | 12.67 | 12.41 | 9.03 | 6.30 | 4.09 | 2.66 | 1.60 | 0.99 | 0.65 | 0.20 | 0.24 | 0.14 | 0.12 | 0.06 | 0.05 | 0.04 |
| NPV@55% | **35.20** | | | | | | | | | | | | | | | | | | | |
| **DF@ 85%** | 0.541 | 0.292 | 0.158 | 0.085 | 0.046 | 0.025 | 0.013 | 0.007 | 0.004 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| PV@85% | (20.55) | (8.39) | 3.93 | 6.77 | 5.23 | 4.29 | 2.62 | 1.53 | 0.83 | 0.45 | 0.23 | 0.12 | 0.07 | 0.02 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 |
| NPV@85% | (2.81) | | | | | | | | | | | | | | | | | | | |

APPENDIX 13: "HI-TECH" Cash flow- Showing cocoa Producer Price Stabilisation -10yrs after the implementation.

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **REVENUE:** | | | | | | | | | | | | | | | | | | | | |
| Added Yield (kg) | 525.06 | 642.50 | 754.16 | 915.96 | 1,128.16 | 1,358.16 | 1,378.53 | 1,399.21 | 1,420.20 | 1,427.30 | 1,448.71 | 1,470.44 | 1,492.50 | 1,514.88 | 1,552.76 | 1,591.57 | 1,631.36 | 1,672.15 | 1,713.95 | 1,756.80 |
| Price /kg | 0.35 | 0.62 | 0.85 | 0.90 | 0.90 | 0.90 | 1.17 | 1.52 | 1.98 | 2.57 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 |
| Total Revenue | 183.77 | 398.35 | 641.04 | 824.36 | 1,015.34 | 1,222.34 | 1,612.88 | 2,128.20 | 2,808.16 | 3,668.86 | 4,654.87 | 4,724.69 | 4,795.56 | 4,867.49 | 4,989.18 | 5,113.91 | 5,241.76 | 5,372.80 | 5,507.12 | 5,644.80 |
| **COST:** | | | | | | | | | | | | | | | | | | | | |
| Mass Spraying | | | | | | | | | | | | | | | | | | | | |
| Gov't contrib. | 7.50 | 9.10 | 12.70 | 14.73 | 16.93 | 19.07 | 23.84 | 29.80 | 37.25 | 46.56 | 58.20 | 72.75 | 90.93 | 113.67 | 130.72 | 150.32 | 187.90 | 234.88 | 293.60 | 367.00 |
| Farmer contrib. | 2.30 | 2.67 | 3.33 | 3.73 | 4.23 | 4.50 | 6.08 | 8.20 | 11.07 | 14.95 | 20.18 | 27.24 | 36.77 | 49.65 | 67.02 | 83.78 | 104.72 | 130.90 | 163.63 | 204.53 |
| Fertilizer | 119.97 | 146.50 | 167.35 | 178.43 | 187.33 | 196.75 | 218.39 | 242.42 | 269.08 | 298.68 | 327.05 | 358.13 | 392.15 | 421.56 | 453.17 | 487.16 | 523.70 | 562.98 | 605.20 | 614.28 |
| Insecticides | 3.40 | 9.83 | 11.97 | 14.70 | 18.33 | 18.30 | 27.45 | 30.20 | 33.21 | 36.54 | 40.19 | 44.21 | 50.84 | 58.47 | 67.24 | 77.32 | 88.92 | 102.26 | 117.60 | 135.23 |
| Fungicide | 1.42 | 1.65 | 2.88 | 3.95 | 4.75 | 5.72 | 14.30 | 18.88 | 24.92 | 32.89 | 43.41 | 57.31 | 64.47 | 72.21 | 80.87 | 90.58 | 101.44 | 113.62 | 127.25 | 142.52 |
| Weeding | 7.50 | 10.57 | 13.10 | 17.33 | 22.10 | 27.10 | 54.20 | 81.30 | 121.95 | 182.93 | 274.39 | 305.94 | 341.13 | 380.35 | 424.10 | 472.87 | 527.25 | 587.88 | 655.49 | 730.87 |
| Pruning | 28.67 | 24.33 | 22.03 | 19.33 | 17.67 | 17.67 | 19.79 | 22.17 | 25.49 | 39.25 | 60.45 | 93.10 | 116.37 | 133.83 | 167.28 | 209.10 | 219.56 | 230.54 | 242.06 | 254.17 |
| Harvesting | 3.53 | 4.70 | 8.30 | 9..67 | 15.17 | 19.67 | 29.51 | 41.31 | 57.83 | 80.96 | 113.35 | 141.68 | 177.10 | 221.38 | 276.72 | 332.07 | 381.88 | 439.16 | 505.04 | 580.79 |
| Pod breaking | 2.97 | 5.93 | 9.97 | 13.27 | 15.97 | 17.53 | 26.30 | 39.44 | 59.16 | 88.75 | 133.12 | 199.68 | 220.14 | 242.71 | 267.59 | 295.01 | 324.66 | 357.29 | 393.20 | 432.72 |
| Conveying | 3.50 | 4.70 | 9.70 | 11.63 | 15.07 | 18.20 | 25.48 | 35.67 | 49.94 | 57.43 | 71.79 | 82.56 | 103.20 | 129.00 | 161.25 | 201.56 | 231.79 | 266.56 | 306.55 | 352.53 |
| Drying | 2.47 | 2.90 | 5.70 | 8.61 | 11.63 | 15.03 | 21.04 | 29.46 | 41.24 | 57.74 | 80.83 | 113.17 | 158.44 | 198.05 | 247.56 | 309.45 | 335.75 | 364.29 | 395.25 | 428.85 |
| Marketing | 2.40 | 4.30 | 7.47 | 12.67 | 13.53 | 16.77 | 26.83 | 42.93 | 68.69 | 109.90 | 153.87 | 215.41 | 301.58 | 376.97 | 414.67 | 456.13 | 481.22 | 507.69 | 535.61 | 565.07 |
| Fixed Input | 5.30 | 10.87 | 15.07 | 18.13 | 19.67 | 20.10 | 35.18 | 61.56 | 107.72 | 188.52 | 329.90 | 577.33 | 721.66 | 739.70 | 832.17 | 852.97 | 874.30 | 896.15 | 918.56 | 941.52 |
| Management | 2.17 | 7.80 | 10.20 | 13.20 | 17.00 | 23.73 | 35.60 | 53.39 | 80.09 | 120.13 | 180.20 | 270.30 | 364.90 | 456.13 | 570.16 | 641.43 | 721.61 | 739.65 | 758.14 | 777.10 |
| Total Cost | 193.10 | 245.85 | 299.77 | 329.71 | 379.38 | 420.14 | 563.97 | 736.71 | 987.65 | 1,355.22 | 1,886.93 | 2,558.80 | 3,139.69 | 3,593.66 | 4,160.51 | 4,659.76 | 5,104.71 | 5,533.85 | 6,017.17 | 6,527.18 |
| NCF | (9.33) | 152.50 | 341.27 | 494.65 | 635.96 | 802.20 | 1,048.91 | 1,391.49 | 1,820.51 | 2,313.64 | 2,767.93 | 2,165.89 | 1,655.87 | 1,273.83 | 828.67 | 454.15 | 137.05 | (161.05) | (510.05) | (882.38) |
| DF@ 55% | 0.645 | 0.416 | 0.269 | 0.173 | 0.112 | 0.072 | 0.047 | 0.030 | 0.019 | 0.012 | 0.008 | 0.005 | 0.003 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| PV@ 55% | (6.02) | 63.48 | 91.64 | 85.70 | 71.08 | 57.85 | 48.80 | 41.77 | 35.25 | 28.91 | 22.31 | 11.26 | 5.56 | 2.76 | 1.16 | 0.41 | 0.08 | (0.06) | (0.12) | (0.14) |
| NPV @ 55% | **561.67** | | | | | | | | | | | | | | | | | | | |
| DF@85% | 0.541 | 0.292 | 0.158 | 0.085 | 0.046 | 0.025 | 0.013 | 0.007 | 0.004 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| PV@ 85% | (5.04) | 44.56 | 53.90 | 42.23 | 29.35 | 20.01 | 14.14 | 10.14 | 7.17 | 4.93 | 3.19 | 1.35 | 0.56 | 0.23 | 0.08 | 0.02 | 0.00 | (0.00) | (0.00) | (0.00) |
| NPV@ 85% | **226.81** | | | | | | | | | | | | | | | | | | | |
| DC @ 55% | 124.58 | 102.33 | 80.50 | 57.12 | 42.40 | 30.30 | 26.24 | 22.11 | 19.13 | 16.93 | 15.21 | 13.31 | 10.53 | 7.78 | 5.81 | 4.20 | 2.97 | 2.08 | 1.46 | 1.02 |
| | 586.00 | | | | | | | | | | | | | | | | | | | |
| DC@ 85% | 104.38 | 71.83 | 47.34 | 28.15 | 17.51 | 10.48 | 7.60 | 5.37 | 3.89 | 2.89 | 2.17 | 1.59 | 1.06 | 0.65 | 0.41 | 0.25 | 0.15 | 0.09 | 0.05 | 0.03 |
| | 305.88 | | | | | | | | | | | | | | | | | | | |

APPENDIX 14: "CODAPEC" Cash flow- Showing cocoa Producer Price Stabilisation -10yrs after the implementation

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **REVENUE:** | | | | | | | | | | | | | | | | | | | | |
| Added Yield (kg) | 62.80 | 78.80 | 139.10 | 211.70 | 274.20 | 366.1 | 371.59 | 377.17 | 382.82 | 388.57 | 393.23 | 405.02 | 417.18 | 431.78 | 479.27 | 498.44 | 518.38 | 520.45 | 541.27 | 562.92 |
| Price /kg | 0.35 | 0.62 | 0.85 | 0.90 | 0.90 | 0.90 | 1.17 | 1.52 | 1.98 | 2.57 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 |
| Total Revenue | 21.98 | 48.86 | 118.24 | 190.53 | 246.78 | 329.49 | 434.76 | 573.67 | 756.96 | 998.80 | 1,263.49 | 1,301.39 | 1,340.43 | 1,387.35 | 1,539.96 | 1,601.55 | 1,665.62 | 1,672.28 | 1,739.17 | 1,808.74 |
| **COST:** | | | | | | | | | | | | | | | | | | | | |
| Mass spraying: | | | | | | | | | | | | | | | | | | | | |
| Gov't contrib. | 5.43 | 7.00 | 8.00 | 9.67 | 11.83 | 12.50 | 14.75 | 17.41 | 20.54 | 24.23 | 28.60 | 36.60 | 46.85 | 59.97 | 76.76 | 98.26 | 115.94 | 136.82 | 161.44 | 190.50 |
| Farmer contib. | 1.13 | 1.23 | 1.60 | 1.77 | 1.87 | 2.23 | 2.72 | 3.48 | 4.46 | 5.71 | 7.30 | 10.08 | 13.91 | 19.19 | 26.49 | 36.55 | 50.44 | 69.61 | 96.06 | 132.56 |
| Insecticide | 1.57 | 2.85 | 6.18 | 6.84 | 8.33 | 9.33 | 11.66 | 14.58 | 18.22 | 22.78 | 28.47 | 35.59 | 44.49 | 55.61 | 69.51 | 83.42 | 100.10 | 120.12 | 144.14 | 172.97 |
| Fungicide | 1.20 | 1.24 | 1.84 | 1.84 | 2.77 | 4.27 | 5.34 | 6.67 | 8.34 | 10.42 | 13.03 | 16.29 | 20.36 | 25.45 | 31.81 | 39.77 | 49.71 | 62.14 | 77.67 | 97.09 |
| Weeding | 4.67 | 6.67 | 9.50 | 13.00 | 16.50 | 20.17 | 27.03 | 36.22 | 48.53 | 65.03 | 87.14 | 108.06 | 133.99 | 166.15 | 186.09 | 208.42 | 233.43 | 261.44 | 292.81 | 327.95 |
| Pruning | 26.07 | 22.67 | 20.17 | 18.00 | 16.67 | 16.67 | 18.34 | 20.17 | 25.21 | 31.52 | 39.40 | 49.24 | 61.56 | 76.95 | 96.18 | 120.23 | 150.28 | 157.80 | 165.69 | 173.97 |
| Harvesting | 3.50 | 6.43 | 7.73 | 9.87 | 11.83 | 13.83 | 18.53 | 23.17 | 28.96 | 36.20 | 45.24 | 56.56 | 70.69 | 88.37 | 110.46 | 148.02 | 198.34 | 265.78 | 356.14 | 477.23 |
| Pod breaking | 2.09 | 5.37 | 6.17 | 7.83 | 9.87 | 11.43 | 17.15 | 25.72 | 38.58 | 57.86 | 86.80 | 130.19 | 195.29 | 214.82 | 236.30 | 249.30 | 263.01 | 277.48 | 292.74 | 308.84 |
| Conveyance | 3.43 | 5.07 | 7.23 | 7.40 | 11.37 | 14.20 | 18.46 | 24.00 | 31.20 | 40.56 | 52.72 | 68.54 | 89.10 | 115.83 | 127.42 | 140.16 | 154.17 | 169.59 | 186.55 | 205.21 |
| Dry cost | 1.93 | 3.80 | 5.97 | 7.60 | 9.33 | 11.80 | 16.76 | 24.46 | 35.72 | 52.15 | 76.13 | 95.17 | 118.96 | 142.75 | 178.44 | 196.28 | 215.91 | 237.50 | 261.25 | 287.38 |
| Marketing | 3.80 | 5.80 | 7.20 | 9.67 | 11.70 | 13.87 | 22.19 | 35.51 | 56.81 | 68.17 | 81.81 | 98.17 | 117.80 | 141.37 | 155.50 | 186.60 | 205.26 | 225.79 | 248.37 | 273.20 |
| Fixed Input | 3.17 | 5.50 | 6.87 | 9.30 | 11.13 | 15.13 | 22.70 | 34.04 | 51.06 | 76.60 | 114.89 | 172.34 | 215.43 | 269.28 | 323.14 | 355.45 | 391.00 | 430.10 | 470.96 | 510.99 |
| Management | 2.00 | 3.93 | 4.87 | 8.40 | 10.27 | 11.93 | 14.91 | 21.62 | 31.35 | 45.46 | 65.92 | 95.59 | 138.60 | 200.97 | 251.21 | 314.01 | 351.69 | 393.90 | 441.16 | 494.10 |
| Total Cost | 59.99 | 77.56 | 93.33 | 111.19 | 133.47 | 157.36 | 210.53 | 287.04 | 398.98 | 536.69 | 727.46 | 972.42 | 1,267.04 | 1,576.71 | 1,869.32 | 2,176.46 | 2,479.30 | 2,808.05 | 3,194.99 | 3,652.00 |
| NCF | (38.01) | (28.70) | 24.91 | 79.34 | 113.31 | 172.13 | 224.23 | 286.63 | 357.98 | 462.12 | 536.02 | 328.97 | 73.40 | (189.36) | (329.36) | (574.91) | (813.68) | (1,135.77) | (1,455.82 | (1,843.26 |
| DF@ 55% | 0.645 | 0.416 | 0.269 | 0.173 | 0.112 | 0.072 | 0.047 | 0.030 | 0.019 | 0.012 | 0.008 | 0.005 | 0.003 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| PV@ 55% | (24.52) | (11.95) | 6.69 | 13.75 | 12.67 | 12.41 | 10.43 | 8.60 | 6.93 | 5.77 | 4.32 | 1.71 | 0.25 | (0.41) | (0.46) | (0.52) | (0.47) | (0.43) | (0.35) | (0.29) |
| NPV@55% | 44.13 | | | | | | | | | | | | | | | | | | | |
| DF@85% | 0.541 | 0.292 | 0.158 | 0.085 | 0.046 | 0.025 | 0.013 | 0.007 | 0.004 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| PV@85% | (20.548) | (8.387) | 3.933 | 6.773 | 5.229 | 4.294 | 3.023 | 2.089 | 1.410 | 0.984 | 0.617 | 0.205 | 0.025 | (0.034) | (0.032) | (0.031) | (0.023) | (0.018) | (0.012) | (0.008) |
| NPV@85% | **(0.511)** | | | | | | | | | | | | | | | | | | | |
| DC@ 55% | 38.705 | 32.283 | 25.063 | 19.264 | 14.919 | 11.348 | 9.795 | 8.616 | 7.726 | 6.705 | 5.864 | 5.057 | 4.251 | 3.413 | 2.610 | 1.961 | 1.441 | 1.053 | 0.773 | 0.570 |
| | 201.41 | | | | | | | | | | | | | | | | | | | |
| DC@ 85% | 32.429 | 22.662 | 14.740 | 9.492 | 6.159 | 3.925 | 2.839 | 2.092 | 1.572 | 1.143 | 0.837 | 0.605 | 0.426 | 0.287 | 0.184 | 0.116 | 0.071 | 0.044 | 0.027 | 0.017 |
| | 99.67 | | | | | | | | | | | | | | | | | | | |

APPENDIX 15: "HI-TECH" Cash flow Showing Removal of Fertilizer Subsidy

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **REVENUE:** | | | | | | | | | | | | | | | | | | | | |
| Added Yield (kg) | 525.06 | 642.50 | 754.16 | 915.96 | 1,128.16 | 1,358.16 | 1,378.53 | 1,399.21 | 1,420.20 | 1,427.30 | 1,448.71 | 1,470.44 | 1,492.50 | 1,514.88 | 1,552.76 | 1,591.57 | 1,631.36 | 1,672.15 | 1,713.95 | 1,756.80 |
| Price /kg | 0.35 | 0.62 | 0.85 | 0.90 | 0.90 | 0.90 | 1.09 | 1.32 | 1.59 | 1.93 | 2.35 | 2.87 | 3.50 | 3.86 | 4.25 | 4.69 | 5.17 | 5.69 | 6.27 | 6.91 |
| Total Revenue | 183.77 | 398.35 | 641.04 | 824.36 | 1,015.34 | 1,222.34 | 1,501.22 | 1,843.73 | 2,264.37 | 2,753.59 | 3,409.77 | 4,222.32 | 5,228.50 | 5,848.23 | 6,605.87 | 7,461.66 | 8,428.31 | 9,520.20 | 10,753.55 | 12,146.67 |
| **COST:** | | | | | | | | | | | | | | | | | | | | |
| Mass Spraying | 99.34 | 116.39 | 101.24 | 70.38 | 46.85 | 30.49 | 20.24 | 13.44 | 8.92 | 5.86 | 3.92 | 2.63 | 1.76 | 1.06 | 0.65 | 0.40 | 0.24 | 0.15 | 0.09 | 0.06 |
| Gov't contrib. | 7.50 | 9.10 | 12.70 | 14.73 | 16.93 | 19.07 | 23.84 | 29.80 | 37.25 | 46.56 | 58.20 | 72.75 | 90.93 | 113.67 | 130.72 | 150.32 | 187.90 | 234.88 | 293.60 | 367.00 |
| Farmer contrib. | 2.30 | 2.67 | 3.33 | 3.73 | 4.23 | 4.50 | 6.08 | 8.20 | 11.07 | 14.95 | 20.18 | 27.24 | 36.77 | 49.65 | 67.02 | 83.78 | 104.72 | 130.90 | 163.63 | 204.53 |
| Fertilizer | 214.27 | 291.41 | 320.55 | 352.60 | 387.86 | 426.65 | 469.31 | 486.21 | 503.71 | 521.85 | 576.64 | 637.19 | 704.09 | 778.02 | 806.03 | 835.05 | 865.11 | 896.25 | 928.52 | 961.95 |
| Insecticides | 3.40 | 9.83 | 11.97 | 14.70 | 18.33 | 18.30 | 27.45 | 30.20 | 33.21 | 36.54 | 40.19 | 44.21 | 50.84 | 58.47 | 67.24 | 77.32 | 88.92 | 102.26 | 117.60 | 135.23 |
| Fungicide | 1.42 | 1.65 | 2.88 | 3.95 | 4.75 | 5.72 | 14.30 | 18.88 | 24.92 | 32.89 | 43.41 | 57.31 | 64.47 | 72.21 | 80.87 | 90.58 | 101.44 | 113.62 | 127.25 | 142.52 |
| Weeding | 7.50 | 10.57 | 13.10 | 17.33 | 22.10 | 27.10 | 54.20 | 81.30 | 121.95 | 182.93 | 274.39 | 305.94 | 341.13 | 380.35 | 424.10 | 472.87 | 527.25 | 587.88 | 655.49 | 730.87 |
| Pruning | 28.67 | 24.33 | 22.03 | 19.33 | 17.67 | 17.67 | 19.79 | 22.17 | 25.49 | 39.25 | 60.45 | 93.10 | 116.37 | 133.83 | 167.28 | 209.10 | 219.56 | 230.54 | 242.06 | 254.17 |
| Harvesting | 3.53 | 4.70 | 8.30 | 9..67 | 15.17 | 19.67 | 29.51 | 41.31 | 57.83 | 80.96 | 113.35 | 141.68 | 177.10 | 221.38 | 276.72 | 332.07 | 381.88 | 439.16 | 505.04 | 580.79 |
| Pod breaking | 2.97 | 5.93 | 9.97 | 13.27 | 15.97 | 17.53 | 26.30 | 39.44 | 59.16 | 88.75 | 133.12 | 199.68 | 220.14 | 242.71 | 267.59 | 295.01 | 324.66 | 357.29 | 393.20 | 432.72 |
| Conveying | 3.50 | 4.70 | 9.70 | 11.63 | 15.07 | 18.20 | 25.48 | 35.67 | 49.94 | 57.43 | 71.79 | 82.56 | 103.20 | 129.00 | 161.25 | 201.56 | 231.79 | 266.56 | 306.55 | 352.53 |
| Drying | 2.47 | 2.90 | 5.70 | 8.61 | 11.63 | 15.03 | 21.04 | 29.46 | 41.24 | 57.74 | 80.83 | 113.17 | 158.44 | 198.05 | 247.56 | 309.45 | 335.75 | 364.29 | 395.25 | 428.85 |
| Marketing | 2.40 | 4.30 | 7.47 | 12.67 | 13.53 | 16.77 | 26.83 | 42.93 | 68.69 | 109.90 | 153.87 | 215.41 | 301.58 | 376.97 | 414.67 | 456.13 | 481.22 | 507.69 | 535.61 | 565.07 |
| Fixed Input | 5.30 | 10.87 | 15.07 | 18.13 | 19.67 | 20.10 | 35.18 | 61.56 | 107.72 | 188.52 | 329.90 | 577.33 | 721.66 | 739.70 | 832.17 | 852.97 | 874.30 | 896.15 | 918.56 | 941.52 |
| Management | 2.17 | 7.80 | 10.20 | 13.20 | 17.00 | 23.73 | 35.60 | 53.39 | 80.09 | 120.13 | 180.20 | 270.30 | 364.90 | 456.13 | 570.16 | 641.43 | 721.61 | 739.65 | 758.14 | 777.10 |
| Total Cost | 287.40 | 390.76 | 452.97 | 503.88 | 579.91 | 650.04 | 814.89 | 980.50 | 1,222.28 | 1,578.39 | 2,136.52 | 2,837.86 | 3,451.63 | 3,950.12 | 4,513.37 | 5,007.64 | 5,446.12 | 5,867.13 | 6,340.49 | 6,874.84 |
| NCF | (103.63) | 7.59 | 188.07 | 320.48 | 435.43 | 572.30 | 686.33 | 863.22 | 1,042.09 | 1,175.20 | 1,273.25 | 1,384.46 | 1,776.86 | 1,898.10 | 2,092.50 | 2,454.01 | 2,982.20 | 3,653.08 | 4,413.05 | 5,271.82 |
| DF@ 55% | 0.645 | 0.416 | 0.269 | 0.173 | 0.112 | 0.072 | 0.047 | 0.030 | 0.019 | 0.012 | 0.008 | 0.005 | 0.003 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| PV@ 55% | (66.86) | 3.16 | 50.50 | 55.52 | 48.67 | 41.27 | 31.93 | 25.91 | 20.18 | 14.68 | 10.26 | 7.20 | 5.96 | 4.11 | 2.92 | 2.21 | 1.73 | 1.37 | 1.07 | 0.82 |
| NPV @ 55% | **262.63** | | | | | | | | | | | | | | | | | | | |
| DF@ 85% | 0.541 | 0.292 | 0.158 | 0.085 | 0.046 | 0.025 | 0.013 | 0.007 | 0.004 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| PV@ 85% | (56.02) | 2.22 | 29.70 | 27.36 | 20.09 | 14.28 | 9.25 | 6.29 | 4.11 | 2.50 | 1.47 | 0.86 | 0.60 | 0.35 | 0.21 | 0.13 | 0.09 | 0.06 | 0.04 | 0.02 |
| NPV @ 85% | 63.60 | | | | | | | | | | | | | | | | | | | |
| DC@ 55% | 185.419 | 162.646 | 121.639 | 87.298 | 64.819 | 46.876 | 37.912 | 29.430 | 23.669 | 19.720 | 17.221 | 14.757 | 11.580 | 8.550 | 6.303 | 4.512 | 3.166 | 2.200 | 1.534 | 1.073 |
| | 850.32 | | | | | | | | | | | | | | | | | | | |
| DC @ 85% | 155.35 | 114.17 | 71.54 | 43.02 | 26.76 | 16.21 | 10.99 | 7.15 | 4.82 | 3.36 | 2.46 | 1.77 | 1.16 | 0.72 | 0.44 | 0.27 | 0.16 | 0.09 | 0.05 | 0.03 |
| | 460.514 | | | | | | | | | | | | | | | | | | | |