UNIVERSITY OF CAPE COAST

COCOA FARMERS' PERCEIVED IMPACT OF THE COCOA HIGH TECHNOLOGY PROGRAMME ON THEIR LIVELIHOODS IN THE EASTERN REGION OF GHANA

BY

MARTIN BOSOMPEM

THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION, SCHOOL OF AGRICULTURE, UNIVERSITY OF CAPE COAST IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN AGRICULTURAL EXTENSION

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CANDIDATE'S DECLARATION

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:..... Date 29/05/2007

Name: MARTIN BOSOMPEM

SUPERVISORS' DECLARATION

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature:..... Date 05/06/07

Name: Prof. J. A. Kwarteng

Co-Supervisor's Signature:..... Date 05/06/07

Name: Dr. Edward Nkyi-Siaw

ABSTRACT

One of the problems accounting for the relatively low level of cocoa production in Ghana is the decline in soil fertility. The Cocoa High Technology Programme (CHTP) was introduced by the Government of Ghana in 2003 with the aim of improving the fertility of the soil thereby increasing the yields and incomes of cocoa farmers.

The study was carried out (using a descriptive-correlational survey design) in Birim South, East Akim, Fanteakwah and Birim North districts in the Eastern Region of Ghana to examine the perceived impact of the CHTP on the livelihoods of cocoa farmers who adopted the technology.

The results from the study revealed that of the 200 respondents interviewed, 74% to 88% implemented all the five components of the programme. The only exception was timely application of fertiliser where only 42% implemented it. Farmers perceived all the five components of the CHTP namely 1. cultural maintenance, 2. fertiliser application, 3. fungicide application, 4. insecticide application, and 5. harvesting, fermentation and drying technologies, to be 'effective' in increasing their yields and incomes.

Generally, cocoa farmers perceived that the overall level of impact of the CHTP on their livelihoods was 'moderately high', i.e. high but below their expectations. Fertiliser and insecticide application components were the major strengths farmers found in the CHTP. Main problems farmers faced were late arrival of fertiliser, high cost of weeding as a result of fertiliser application, unavailability of spraying machines and inadequate training and supervision by Agricultural Extension Agents (AEAs).

The study further revealed that farmers' yields were significantly improved by the CHTP with mean increase of 72% (from 2.85 bags/acre to 4.9 bags/acre), three years after the implementation of the CHTP. However, the yields were below the expected CHTP yield of 10 or more bags/acre. The mean age of cocoa farmers in the area was 56 years with more than half (54.5%) possessing the Middle School Leaving Certificate. The mean number of years of experience of cocoa farmers was 24. The average land area under cocoa cultivation was 10.5 acres (4.2 ha).

There were positive and substantial significant relationships between impact on livelihoods of farmers and each of the five main components of the CHTP at 0.05 alpha level.

The results of stepwise multiple regression analysis revealed that (1) fertiliser application; (2) harvesting, fermentation and drying technologies; and (3) fungicide application were the best predictors of impact on livelihoods of cocoa farmers, who adopted the CHTP in the study area, with fertiliser application being the overall best predictor variable.

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DEDICATION

To my father, Mr. John Bosompem; mother Mrs. Nancy Bosompem; brother Kwasi Bosompem and sister Sandra Bosompem.

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LIST OF ACRONYMS

AEAs : Agricultural Extension Agents

AKAP : Awareness-Knowledge-Adoption - Productivity

ASARECA : Association for Strengthening Agricultural Research in Eastern and Central Africa.

CHTP : Cocoa High Technology Programme

COCOBOD : Ghana Cocoa Board

CODAPEC : Cocoa Disease and Pests Control Programme

CRIG : Cocoa Research Institute of Ghana

CSSVD : Cocoa Swollen Shoot Virus Disease

CTA : Technical Centre for Agricultural and Rural Cooperation.

DfID : Department for International Development of United Kingdom

ECART : European Consortium for Agricultural Research in the Tropics

FASDEP : Food and Agriculture Sector Development Policy

GDP : Gross Domestic Product

ICCO : International Cocoa Organization

IITA : The International Institute of Tropical Agriculture

ISSER : Institute of Statistical, Social and Economic Research

KASA : Knowledge, Attitudes, Skills and Aspirations

LBCs : Licensed Buying Companies

MoFA : Ministry of Food and Agriculture (Ghana)

NGOs : Non-Governmental Organisations

PRMPR : Poverty Reduction Group

SVD	: Social Development Department.
PCs	: Purchasing Clerks
QCD	: District Quality Control
R&D	: Research and Development
RoR	: Rate of Return
SRL	: Sustainable Rural Livelihood
WACRI	: West Africa Cocoa Research Institute

CHAPTER ONE

INTRODUCTION

Background to the Study

Agriculture is the most dominant sector in Ghana's economy contributing about 36.7 % of the GDP (including fishing and forestry), and employing about 60% of the labour force (ISSER, 2005). Cocoa (*Theobroma cacao*, L.) is a major export crop with over one hundred years of history in Ghana. Cocoa is the dominant tree crop in Ghana, accounting for 20.5% of Ghana's export earnings, 3.3% of GDP and the sub-sector also employs 24% of labour force (FASDEP, 2002). Cocoa accounts for 55% of the total household income among cocoa farmers in Ghana (IITA, 2002). Until mid-1960s Ghana used to be the World's largest producer of cocoa, with the production hitting a peak of 560,000 metric tonnes in 1964/65 when it accounted for 38% of global output (Appiah, 2004a).

The level of socio-economic development in Ghana therefore depends largely on the significant growth and development of the cocoa industry. Global cocoa production has risen steadily from an average of about 1.28 million tonnes in the 1960s to 3.02 million tonnes in 1999/2000 (Ghanaian Chronicle, April 22, 2004). Currently, West Africa produces 70 percent of the world's cocoa, with Côte d'Ivoire and Ghana supplying 40 and 25 percent of global consumption respectively (Dizolele, 2005).

Cocoa production and yields in Ghana have been declining over the years. Ghana has been overtaken by La Cote d'Ivoire's production with its share of the global output declining to a range between 10.7 - 12% during the last 10 years. The average national annual yield in Ghana, around 350 kilograms per hectare (kg/ha), is very low compared to 800 kg/ha in Côte d'Ivoire, or 1700 kg/ha in Malaysia (Appiah, 2004a).

The relatively low yield of cocoa in Ghana has been attributed to a number of reasons including high incidence of pest and diseases (such as capsids, swollen shoot virus disease (CSSVD), and black pod disease), decline in soil fertility and inconsistency in rainfall pattern. Also, a greater number of farmers, according to Eponou (1993), are still using primitive technologies in this era where biotechnology and other scientific innovations give farmers a basket of options to choose from.

Efforts have been made by Ghana Government and research institutions in the past to solve some of these problems. The British Government, in1938, established the West Africa Cocoa Research Institute (WACRI) now the Cocoa Research Institute of Ghana (CRIG) with the mandate to research into problems affecting production and utilization of cocoa in West Africa. Some of the achievements of CRIG are the control of capsids, characterization of cocoa swollen shoot disease as caused by a virus, discovery of mealy bugs as vectors of the virus and the control of the disease by eradication, and development of early bearing and high yielding hybrids (Appiah, 2004a).

Efforts to boost cocoa production are ultimately aimed at improving the livelihoods of farmers and alleviate poverty. These efforts include the Cocoa Disease and Pests Control Programme (CODAPEC), popularly known as mass spraying, the Cocoa High Technology Programme (popularly known as 'Cocoa Hi-tech', which aims at introducing farmers to soil fertility management practices, and the control of the swollen shoot virus disease (CSSVD).

Statement of the Problem

Since the cocoa sector is a major source of employment for agricultural labour force, the socio-economic development of Ghana would depend largely on the significant growth of the sector. A rise in cocoa production also earns the country more foreign exchange. The low yield/unit area recorded by most farmers has resulted in some socio-economic problems such as rural poverty and rural-urban migration, deforestation and land degradation.

People, especially the youth, migrate from rural areas to urban centres in search of non-existing jobs as a result of rural poverty. In order to compensate for the decline in income due to low yield per unit area, farmers leave their old uneconomic farms for areas where forest abounds thereby causing deforestation. Also the non-replenishment of nutrients removed from the soil annually through crop harvest has led to degradation in soil fertility in cocoa growing areas with consequential decline in yield. Lack of adequate financial resources results in low productivity of cocoa farmers who, then are unable to carry out good agronomic practices.

The causes of the decline of cocoa production within the last 40 years have been attributed to drought with attendant bush fires, old age of trees and farmers, pest and diseases, soil fertility decline and low producer price (Appiah, 2004a). The Cocoa Hi-Tech Programme (CHTP) was therefore designed to ultimately 'arrest' most of these problems above. (Appiah, 2004a) reported that the introduction of the CHTP, which aims at improving soil fertility has helped improve yields and income of most cocoa farmers and this has enabled them to buy more inputs for their farming activities. In addition, youths were reportedly being attracted into cocoa farming since cocoa farming is now seen as a profitable venture (Appiah, 2004a).

The CHTP involved the use of a holistic approach to increase cocoa yields but it mainly concentrates on the increase of soil fertility. Measurement of impact of the CHTP has centered mostly on the yield and income of cocoa farmers. For example, Appiah (2004a), reported that there has been an increase in cocoa yields since the adoption of the programme and in 2002/03 season, a production figure of 497,000 metric tonnes was achieved, the second highest production ever achieved in Ghana.

However, the perceived impact of the programme on other aspects of farmers' livelihoods such as productivity (yield per unit area), access to labour and extension services, financial savings and debt level; ownership access to productive equipment (example vehicles, sprayers and prunners) have not been fully examined. The perceived effectiveness of the CHTP as a whole, as well as its various components, needs to be assessed by the beneficiary farmers. According to Rogers (1983), people's (farmers') perceptions about a

programme are very important in adoption and sustainability of a programme or an innovation in a social system. Therefore, a research designed to assess the impact of CHTP on farmers' livelihoods should not only concentrate on yield and income but should extend to the other relevant aspects of their livelihoods as well as the perceptions of farmers about the effectiveness of the programme.

The Objectives of the Study

General Objective:

The main objective of the study was to examine the perceived impact of the Cocoa High Technology Programme (CHTP) on the livelihoods of farmers in the Eastern Region of Ghana.

Specific Objectives:

Specifically, the study was to:

i. find out perceptions of farmers on the effectiveness of the main components of the CHTP programme namely:
   - Cultural Maintenance,
   - Application of fertiliser,
   - Application of fungicides,
   - Application of insecticides, and
   - Harvesting of cocoa pods.

ii. examine the level of perceived impact of the CHTP on the livelihoods of cocoa farmers with respect to the following:

- **Natural capital** - Yield and productivity (yield per unit area/cost)
- **Physical capital-** Ownership and access to productive machinery and equipment (vehicles, sprayers, prunners and harvester.).
- **Financial capital** -Income levels, financial savings, debt levels and access to credit.
- **Human capital** -. Access to labour (skilled and unskilled) and extension services (public and private).
- **Social capital-** Membership to organizations, support to family members, friends, ability to pay school fees.

iii. compare the level of perceived impact of the programme on farmers' livelihoods among the four districts of the study.

iv. find out farmers' perceptions about the problems and strengths of the programme and how the problems may be solved.

v. compare the level of perceived effectiveness of the programme between male and female cocoa farmers.

vi. examine the following demographic and farm related characteristics of cocoa farmers namely, age, educational level, years of experience, household size, size of cocoa farm, number of cocoa farms and yield of farmers.

vii. compare the estimated yield of cocoa farmers before and after they adopted the CHTP.

viii. explore relationship between the farmers' perceived level of effectiveness of the main components of the CHTP and perceived impact on livelihoods of farmers.

ix. identify the best predictor(s) of impact of the programme on livelihood from the main components of the CHTP.

Research Questions

1. What is the level of effectiveness of each of the main components of the CHTP as perceived by the cocoa farmers?
2. What is the level of impact of the CHTP on each of various aspects of farmers' livelihood as perceived by the cocoa farmers?
3. What are the problems and strengths of the CHTP as perceived by the farmers?
4. Is there any significant difference between male and female cocoa farmers' perceived effectiveness of the CHTP?
5. Are there any significant differences in the level of perceived impact of the CHTP on farmers' livelihoods among the four districts in the region of study?
6. Is there any significant difference between the estimated yields of cocoa farmers before and after they adopted the CHTP?
7. Is there any relationship between the perceived effectiveness of each of the main components of the CHTP and the perceived impact on farmers' livelihoods?

8. What are the best predictor(s) of impact on livelihood among the main components of the CHTP?

Research Variables

The Dependent Variable

The dependent variable of the study is the **perceived impact on livelihoods.** Livelihood is categorised into five different livelihood assets and outcomes namely:

- Natural capital,
- Physical capital,
- Financial capital,
- Human capital, and
- Social capital.

The Independent Variables

The independent variables in the study include the following:

- Demographic characteristics : age, sex, educational level, years of experience and household size,
- Farm related factors: farm size, number of farms, age of cocoa farm and yield of farmers, and
- The Cocoa High Technology Programme (CHTP): The main components are Cultural maintenance, fertiliser application, fungicides spraying, insecticides spraying and harvesting of cocoa pods.

Hypotheses of the study

The following main hypotheses were formulated to be tested at 0.05 alpha level:

1. **H_O: There are no significant differences in the levels of perceived impact of the CHTP on farmers' livelihoods among the four districts of the study.**

   H_1: There are significant differences in the level of perceived impact of the CHTP on farmers' livelihoods among the four districts of the study.

2. **H_O:** There is no significant difference between male and female farmers' perceived effectiveness of the CHTP.

   H_1 : There is a significant difference between male and female farmers' perceived effectiveness of the CHTP.

3. **H_O:** There is no significant difference in the estimated yields of farmers before and after the adoption of the CHTP.

   H_1: There is a significant difference in the estimated yields of farmers before and after the adoption of the CHTP.

4. **H_O:** There is no significant relationship between perceived impact of the CHTP on farmers' livelihoods and farmers perceived effectiveness of each of the five (5) main components of the CHTP.

   H_1: There is significant relationship between perceived impact of the CHTP on farmers' livelihoods and farmers' perceived effectiveness of each of the five (5) main components of the CHTP.

Justification of the Study

The study seeks to assess the effectiveness of CHTP, its impact on the lives of beneficiary farmers and how the programme may be improved if the need be. The result of the study could contribute to assessing the cost-benefit analysis of the programme to ascertain whether it is worth continuing.

Based on the crucial role information plays in the formulation and implementation of agricultural policies, results from the study could provide useful information to assist government in setting priorities and formulating policies concerning improvement and sustainability of the CHTP.

The outcome of the study with respect to the effectiveness of the various components of the programme would serve as a useful guide to trainers and Agricultural Extension Agents (AEAs) when training farmers on the various components of the programme.

Furthermore, the study would serve as a guide for other stakeholders such as NGOs, private operators, banks, Licensed Buying Companies (LBCs) in the cocoa industry, who may want to promote cocoa production.

The study will also add to the body of knowledge so far as impact on livelihoods is concerned especially in the field of the CHTP. This is because other works on CHTP concentrate much on the improvement on farmers' yields and incomes neglecting other aspects of their livelihoods.

Limitations of the Study

The following limitations militated against the conduct of the study:

1. In the absence of adequate record keeping by farmers, the study relied on farmers' power of memory recall.
2. The study covered four (4) districts out of nine (9) districts that began the CHTP in the Eastern Region due to limitations of resources, time, and funds.

Delimitations of the Study

1 The study assessed the impact of CHTP on livelihood of cocoa farmers who have **adopted** the programme but not all cocoa farmers in the study area.

2 The study did not compare the investment in the technology development effort to the value of the results, measured in terms of yield, income gains or rate of returns.

Definition of Terms

This section indicates the operational definition of terms used in the study.

Adoption: Acceptance and use of agricultural technologies for one or more seasons.

Effectiveness: Defined in the context of this study as the degree to which the result of CHTP is perceived or observed by farmers through extension education, adoption of improved agricultural technologies and yields of farms.

Livelihoods: Assets, activities and access that determine the living gain by Individuals or households. Livelihood and capital are used interchangeably in this study.

Natural capital: Yield and productivity (yield per unit area or cost).

Overall Livelihood: Combination of natural, Physical, Financial, Human and Social capitals of an individual.

Physical Capital: Ownership/access to productive equipment (vehicles, sprayers, prunner, harvester).

Financial Capital: Income levels, financial savings, debt levels.

Human Capital: Access labour, extension services etc.

Social Capital: Membership to organizations, support to family members and friends, and ability to pay school fees.

Perception: Personal indications to disregard some things emphasise and put meaning in ones' own way. Perceptions, opinions and attitudes have the same meaning in this study.

Perceived Impact: The degree to which farmers regard CHTP to have improved or retarded any aspect of their livelihoods.

Productivity: The output per unit area or cost of input as perceived by farmers.

Technology: The machines, tools, mechanical devices, planting materials, Instruments and techniques adopted for practical purposes of producing cocoa.

The Study Area

The Eastern Region occupies a land area of 19,323 square kilometres and constitutes 8.1 per cent of the total land area of Ghana. It is the sixth largest region in terms of land area. It lies between latitudes 6 ° and 7 ° North and between longitudes 1°30' West and 0°30' East. The region shares common boundaries with the Greater Accra, Central, Ashanti, Brong Ahafo and Volta Regions (Figure 1). Temperatures in the region are high and range between 26 °C in August and 30 °C in March. The relative humidity which is high throughout the year varies between 70 per cent and 80 per cent (http://www.ghanadistricts.com/region).

The region lies within the wet semi-equatorial zone which is characterised by double maxima rainfall in June and October. The first rainy season is from May to June, with the heaviest rainfall occurring in June while the second season is from September to October, with little variations between the districts. The major occupation of the people in the region is agriculture and related works (54.8%) (http://www.ghanadistricts.com/region).

The Eastern Region is the third (3^{rd}) largest producer of cocoa in Ghana (out of the six regions) accounting for about 15% of the cocoa produce in Ghana (COCOBOD, 2005). Notable among the major districts that produce cocoa in the region are Birim South, East Akim, Fanteakwah, Birim North, West Akim, Kwahu South, Suhum Kraboa Coaltar, New Juabeng and Kwaebibrem. About 60 percent of farmers in the region earn their income from cocoa. The region produces an average of about 50,923 metric tonnes of cocoa per annum (COCOBOD, 2005).

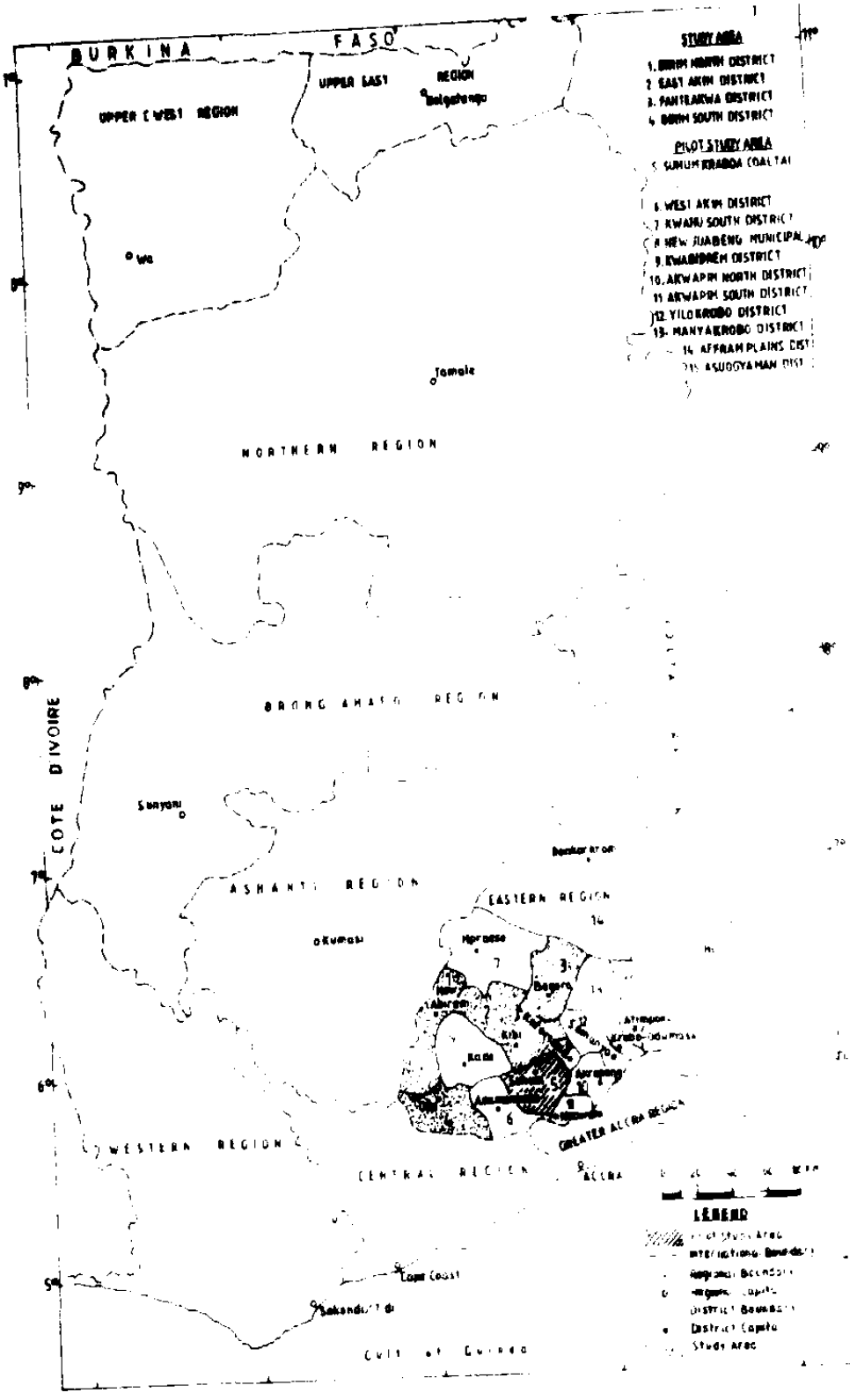

Figure 1: Map of the Study Area

CHAPTER TWO

LITERATURE REVIEW

General Overview

The literature review tries to pull together the existing theoretical and empirical studies that provide the background and necessary basis for the study. This chapter attempts to review relevant works done on various aspects of CHTP: the technology development and dissemination, with emphasis on the impact of the programme on livelihood of farmers, who adopted it. It captures various designs of impact assessment and as well as livelihoods and indicators for measuring livelihoods. Furthermore, it reviews perceptions as well as demographic and farm-related characteristics of farmers.

Global Cocoa Production

Cocoa (*Theobroma cacao* L.) belongs to the family Sterculiaceae and has two main types, the Criollo which is the commonest type and contributes about 10% of world cocoa production; and the Forastero, which yields smaller, flatter and purple beans. A third variety called Trinitario is more disease-resistant hybrid of the Criollo and Forastero and is regarded as flavoured beans (Lees and Jackson, 1973). Cocoa production in the world has risen steadily from an average of 1.28 million tonnes in 1960s to 3.02 million tonnes in 1999/2000, and in 2002/03 growing season, the world production reached 3,102,000 tonnes (ICCO, 2003).

Cocoa Production in Ghana

Africa produces about 70% of the world's Cocoa output of which Cote d'Ivoire and Ghana dominate. Ghana (formerly Gold Coast) became the leading producer of cocoa in the world in 1920/21 season and maintained the lead till 1977/78 season when La Cote d'Iviore took over the lead (Appiah. 2004b). Furthermore, Ghana was overtaken by Indonesia in 2001/02 season therefore dropped to the third world's largest producer. Currently, Ghana is the second leading producer of cocoa in the world. Ghana cocoa production generally fluctuated but reached an all time peak of 560,000 metric tonnes in 1964/65 season.

Even though cocoa production in Ghana has increased over the years, the increase has not been attributed to increase in yield per unit area, but to a larger extent, expansion of existing farms or development of new farms especially in the Western Region of Ghana where forest land is abundant. The average national annual yield in Ghana (350kg/ha) is relatively low compared to Cote d'Iviore (800kg/ha). The low yield/unit area produced by cocoa farmers in Ghana has negative socio-economic impact on farmers (Appiah, 2004b). Such negative consequences include rural poverty and rural-urban migration, deforestation and soil degradation. Poor agronomic practices could also be both cause and effect of low cocoa yields (as a result of low financial resources, farmers are not able to carry out good practices such as pest and disease control and weeding, for example).

Causes of Decrease in Cocoa Yield in Ghana

Decline in cocoa yield, especially between 1960s - 80s, was attributed to the following reasons:

- Drought,
- Old age of trees,
- Pest and diseases,
- Soil fertility decline, and
- Low prices.

The serious and prolonged drought in the early 1980s accompanied by bushfires destroyed about 30-40% of the cocoa farms in Ashanti, Brong Ahafo, Eastern and Volta regions of Ghana and few farms were replanted. It is also estimated that about 30% of current land area under cocoa cultivation accounts for very little in yields and incomes of farmers due to old age of cocoa trees. Inability to control Cocoa Swollen Shoot Virus Disease, Black Pod Disease, and capsids; poor farm maintenance practices as well as low producer prices in 1980s were significant factors that resulted in decline in production. Another important factor that contributed greatly to the decline in cocoa yield in Ghana was the depletion of the soil nutrients without replenishing it with fertiliser.

Cocoa Research Institute of Ghana (CRIG) has been carrying out research into these problems at the farm level. Some of the achievements of CRIG are control of capsids, characterization of cocoa swollen shoot disease as caused by a virus, discovery of mealy bugs as vectors of the virus and control of the disease by eradication of infected trees, and development of early-bearing and high-yielding hybrids. Furthermore, as a result of the

research work conducted by CRIG, the government of Ghana, in 2001, initiated two important programmes namely the Cocoa Pest and Disease Control Programme (CODAPEC) and Cocoa High Technology Programme (Cocoa Hi-Tech).

Nature of Agricultural Technology

At the most theoretical level, technology is the application of knowledge for practical purposes and it is used to improve the human condition, the natural environment, and or to carry out other socio-economic activities. According to Swanson (1998), agricultural technology can be classified into two major categories: (1) *material technology*, where knowledge is *embodied* into a technological product such as tools, equipment, agrochemicals, improved plant varieties or hybrids, improved breeds of animals (e.g., semen from progeny-tested sires used for artificial insemination), and vaccines, and (2) *knowledge-based technology* such as the technical knowledge, management skills, and other processes that farmers need to successfully grow a crop or produce animal products.

The transfer of *material* technology to farmers generally involves the production, distribution, and sale of seeds, implements, agrochemicals, and other production inputs. Swanson (1998) asserted that the transfer process for material technology is generally simpler than training for and dissemination of technical knowledge and management skills to large numbers of poorly educated farmers, who operate in different agro ecological zones (i.e., the extension function). Also, the delivery systems needed for these different types of technologies are

generally different. In most cases, the private sector is best suited to produce and distribute material technology.

On the other hand, most *knowledge-based* technologies such as improved crop or livestock management practices, integrated pest management (IPM), and soil and water management practices are generally taught through vocational training programmes for rural young people or disseminated through a publicly-funded extension system for adult farmers (Swanson, 1998).

At the same time, most material technology requires technical knowledge so that these products or tools can be used effectively. For example, to properly use an agrochemical in pest management, farmers need to know the proper application rates, the time and conditions for application, safety procedures, and so forth. In addition, if farmers use a sprayer (another type of material technology) to apply agrochemicals, then they need to know how to operate, adjust, calibrate, and clean the equipment to achieve the best results. Therefore, material and knowledge-based technologies are generally closely intertwined. Private sector firms in developing countries have very limited technical capacity to train farmers in these product-related skills and knowledge, therefore, the transfer of most knowledge-based technologies is, by design or by default, left to the national or provincial extension system (Swanson, 1998).

The Cocoa High Technology Programme (CHTP)

The 'High Technology' of cocoa production is defined as "the 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 of resources" (COCOBOD, 2002, p. iv). The programme emphasises the use of fertiliser and proper farm management practices to achieve higher cocoa yields.

The reason why the programme emphasises the use of fertiliser was the fact that though considerable data on responses of cocoa to fertilisers have been generated over the years at CRIG, very little impact of the soil fertility management has been made on farmers' cocoa farms. The use of fertiliser was not economically feasible due to relatively low responses of cocoa to the fertilisers as a result of high inherent soil fertility problems, and low producer prices (Appiah, 2004b). A survey conducted by CRIG in 1990 showed that virtually no cocoa farmer in Ghana included soil fertility maintenance in his or her farm management programme, though fertiliser application has been adopted in other cocoa producing countries on the bases of earlier result at CRIG. A research programme was, therefore, initiated in the early 1990s to evaluate the agronomic, environmental, social and economic implications of fertiliser use on some peasant cocoa farms in Ghana with the aim of introducing fertiliser to farmers and thus help attain sustainable cocoa production in Ghana. This initiative resulted in the need to introduce the CHTP.

The Research Programme that led to CHTP

According to Appiah, Ofori-Frimpong, Afrifa, and Asante (1997) and Appiah (2004b), on-farm fertiliser verification trials began in the Ashanti Region in 1991/92 cocoa season and ended in 1994/95 season. Twenty (20) peasant cocoa farmers were selected from six growing districts in the Ashanti Region of Ghana and soil surface samples (0-15cm and 15-30 cm) were collected from each farm for regular chemical analysis. A plot of 1.6ha (4 acres) was marked from each farm and divided into two equal halves along the slope. Triple or single supper phosphate and murate of potash at the rate of 129kg P_2O_5 and 76.5kg K_2O per hectare per year respectively were applied on one-half of each plot between March and May each year and before the rains: whiles the other half did not receive fertiliser. All the expenses on the farm operations were borne by the farmer except cost and application of fertiliser which were borne by CRIG. The trial continued for four (4) years.

Fertiliser use on cocoa pilot project immediately followed the verification trials. One (1) acre (0.4 ha) of each farmer's farm was demarcated for fertiliser application at the rate used for the verification trials. Soil samples were collected and sent to CRIG for analysis at a fee of thirty thousand cedis (¢30,000) per farmer per soil sample analysis. This time, the farmer bore the cost of the fertiliser, its application and other farm operations.

The Result and Impact of the Pilot Project of the CHTP

The result of the on-farm verification trials showed that 25% of the total number of fertilised plots had yields exceeding 1000kg/ha at the end of first year, and at the end of fourth year, it increased to 75%. Twenty five percent (25%) of the farm had 2000kg/ha at the end of the fourth year. The result, therefore, revealed significant responses of cocoa to fertiliser application on experimental farms (average of 13000kg/ha) and this was higher than the national average (350kg/ha or 140kg/acre). It was seen that if the results from the trials are extrapolated on the national scale, the national production could be doubled within a four year period (Appiah et al., 1997; Appiah, 2004b).

The income of farmers who participated also increased considerably as compared to those of unfertilised farms. For example, the economic analysis of the results of the Ashanti fertiliser verification trials at the end of the four-year period indicated that the use of fertilisers on small-holder cocoa farms was highly profitable. The Marginal Benefit-Cost Ratio (MB/C) ranged from 1.25 in the first year to 3.65 in the fourth year of the cocoa season. Marginal Rate of Returns (MRR) on investment also ranged from 25% in the first year to 265% by the fourth year. This was highly acceptable to farmers because the minimum rate of returns on investment that farmers were prepared to accept was between 50-100% (Marginal Rate of Returns or Benefit Cost Ratio of 1.5 - 2.0).

Adoption rate between the period also increased due to the formation of association known as the 'Ye Wo Cocoa Fuo Yie' (Maintain Your Cocoa

Farm) Association. A survey conducted among participating farmers in the trial areas indicated farmers would prefer to stay on the same farm with the yields and financial returns they obtained from existing farms rather than develop new farms. The bean size and weight also increased considerably on fertilised farms than unfertilised ones. Farmers were able to improve agronomic practices as a result of adequate remuneration obtained from yields of fertilised farms. Furthermore, they were also able to obtain more input required for agronomic practices such as black pod and capsids control, mistletoe removal and weeding of those participating farms.

One of the major outcomes of the pilot project was that employment was generated for the rural youth which is a major problem in Ghana. This was so because whereas on the average, almost all pods were harvested at three harvest times from unfertilised farms, the frequency of harvesting on fertilised farms was about nine harvests per year. The increased frequency of harvest as well as the improved cultural and agronomic practices created job opportunities for the rural youth thereby reducing the frequency of the migration of rural youth to the urban areas.

Guidelines for implementation of the CHTP

The Cocoa Research Institute of Ghana (CRIG), a division of COCOBOD, is mandated by COCOBOD to see to the smooth running of the programme. The follow guidelines are used by CRIG for the implementation of the programme (CRIG, 2004).

Coverage of the CHTP

Each selected farmer applies the High-Tech methods to two (2) acres of his or her cocoa farms. Farmers who participated in the project in last season and are benefiting again from the subsequent season are expected to apply the method on the same two (2) acre area used the last season.

Selection of Cocoa Farmers

Licensed Buying Companies (LBCs) with local Purchasing Clerks (PCs) select genuine and credit-worthy farmers after prior consultation with (and approval by) their District Managers and submit the list to the District Vetting Committee in each district. The Committee is the sole authority that is responsible to vet and approve the list submitted by LBCs. The Vetting Committee consists of the following:

- The representative of the District Assembly (preferably the District Assembly's Cocoa High Tech. Co-coordinator.
- The district managers of the Licensed Buying Companies (LBCs) in the district.
- The District Director of MoFA or his Representative, and
- The COCOBOD District Quality Control (QCD) Manager who serves as the chairman of the Vetting Committee.

After vetting, selected and approved farmers then fill application forms endorsed by the District Manager or Purchasing Clerk (PC) of the LBC who will be the sponsor of the farmer selected. Farmers who participate in the programme are expected to pay at least 1 million Cedis to the sponsoring

LBC, as part of their credit repayment, before they are selected to participate or benefit from the subsequent season's package. The sponsoring LBCs are expected to deduct the rest of the money from farmers' sales by the end of the season.

Storage and Distribution of Inputs to Beneficiary Farmers

The following are arrangements made for storage and distribution of inputs:

- COCOBOD arranges for the transport of the inputs (fertiliser, insecticides, and fungicides) to the participating District Assemblies.
- The District Director of MoFA and the District Assembly's Coordinator for Cocos High Tech. are responsible for receiving the inputs and ensuring their safe storage.
- COCOBOD/Implementation Committee determines the appropriate cost of storage and related expenses based on a flat rate per bag and re-imburse District Assemblies accordingly.
- LBCs/PCs collect the inputs from the District Assembly according to the yields and the approved list of farmers by the Vetting Committee.
- The District MoFA Director and District Assembly's Coordinator for Cocoa High Tech are responsible for distribution to the LBCs/PCs and then LBCs/PCs to the beneficiary farmers, and
- COCOBOD then re-imburse the LBCs/PCs the cost of transporting the inputs to various communities.

Recovery of Credit (Loan) for the CHTP

LBCs/PCs are solely responsible for recovering the loan from the selected farmers. The COCOBOD management, in consultation with LBCs/PCs, then works out a schedule for collecting at source, repayments of the loan from the buyer's margins of participating LBCs. The LBCs, in turn, work out their own arrangements to collect repayments from their District managers or PCs.

Remuneration for Monitoring the CHTP

The Implementation Committee determines appropriate remuneration for MoFA staff (AEAs) and the District Assembly's Coordinator for Cocoa High Tech. to cover their transportation claims for their monitoring activities.

The Components of CHTP

The holistic approach of the Cocoa Hi-Tech includes five (5) main components:

- Cultural maintenance of farm,
- Application of fertiliser,
- Spraying of fungicide,
- Spraying of insecticide, and
- Harvesting, fermentation and drying technologies.

Cultural Maintenance of Farm

Cultural maintenance involves preparing the farm to receive the cocoa fertiliser. It involves weeding of the farm, removal of basal chupons, overhead canopies, dead husk and mistletoes because they feed and compete with cocoa trees. All Ceiba trees and palm trees are also removed from the farm. All cola trees are removed because they serve as alternative host for capsids. To ensure that rain water drains away during the raining season, trenches (gutters) are dug in water-logged farms to serve this purpose.

The main aim of the cultural maintenance is to avoid the competition between cocoa trees and aforesaid trees, and also prepare cocoa plants for fertiliser or nutrient so that cocoa trees would make maximum use of the available nutrients. Cultural maintenance normally begins before the first flower appears each year (i.e. between January-March).

Application of Fertiliser

The next activity that follows immediately after the cultural maintenance is the application of fertiliser (the main component of the programme). The replacement of nutrients to the soil is very important because once a crop is harvested the nutrients that it used for growth are permanently lost from the soil (Pidwirny, 2002). If the same crop is grown repeatedly or allowed to grow on the same field, as is done in conventional agriculture, many of the micronutrients such as boron, zinc and manganese are depleted. Inorganic fertilisers were developed to increase plant yields by

supplying plants with the necessary nutrients that are in short supply to stimulate growth. These fertilisers are commonly composed of nitrogen, phosphorus and potassium.

According to Pidwirny (2002), inorganic fertilisers generally, have the benefits in that they produce high yields, are easy to apply and are relatively inexpensive. He added that the price of inorganic fertilisers, however, can vary because the production of fertiliser relies so heavily on oil and consequently its price in the world market. It is estimated that approximately 25% of the world's crops today are directly attributable to the use of inorganic fertilisers and due to this success the demand for inorganic fertilisers has been doubling every 10 years (Pidwirny, 2002). Appiah, et al. (1997) reported a doubling of yields in Ghana from the application of 4.94 bags (50kg/bag) of triple super phosphate and 2.47 bags (50kg/bag) of muriate of potash per hectare over a four year period. Edwin and Masters (2003) also reported from a survey done in Ghana that the use of fertiliser is associated with 21 percent higher yields and that is close to the world's estimate of 25 %.

The CHTP generally uses a special kind of fertiliser known as "Asase Wura Special Cocoa Fertiliser". The active ingredients of the fertiliser are sulphur, magnesium, phosphorus and potassium [NPK O-22-18 + 9CaO + 7S + 6MgO (s)] and are very important for development of cocoa plant. The rate of application is 300-400 grams/tree/year and it is applied 70-100 cm around each cocoa tree trunk. It can also be applied by broadcasting method. In either case, three bags (50kg/bag) of the fertiliser are applied per acre. It is recommended that the fertiliser be applied between April-May, August-September or at the beginning of the rainy season.

Spraying of Fungicides

The Black Pod disease is one of the most devastating diseases of cocoa caused by fungus, *Phytophthora*. Under the CHTP, two fungicides Ridomil Plus 72 WP and Nordox Super 75 are used to control Black Pod disease.

McGregor(1981) evaluated the effectiveness of five (5) fungicides (Ridomil, Aliette, Curzate.CC, Nordox, Previcur.N and Terrazole) against this fungus and found that Ridomil and Nordox gave a substantial and significant reduction in number of infections arising from zoospore, and significantly reduced percentage *Phytophthora* pod rot on field. However, when he further evaluated these two, Ridomil was found to be more cost effective and more acceptable to the cocoa farmers than Nordox.

It is recommended that Rindomil Plus 72 WP is sprayed between May-August or when cherelles (young cocoa pods) appear. The application rate is six (6) sachets per acre (one sachet =100 grams/15 litres). It is also recommended that pods are sprayed every 3-4 weeks until the pods are ripe. Nodox Super 75 is a powerful fungicide used against the Black Pod disease. It is a wettable powder with 75% copper in the form of cupreous-oxide (Cu_2O). It is also applied at the rate of 6 sachets per acre. One sachet (100grams) of the fungicide is mixed with 15 litres of water. It is recommended that pods must be sprayed every four (4) weeks until the pods are ready for harvesting.

Spraying of Insecticides

The major pest of cocoa is the capsid which destroys cocoa trees and pods. Under CHTP, a pesticide known as Confidor 200 SL is used to control capsids. Spraying starts from August and continues at monthly intervals till the

pods are ripe for harvesting. Thirty (30) mls of Confidor 200 SL is mixed in 12 litres (a tankful) of water and sprayed using a motorized mist blower. The rate of application is 2 tankfulls of mixture per acre per application. It is also recommended that Confidor 200 SL should be applied soon after harvesting to maintain canopy protection and to prepare the farm for the next season.

Insecticides, like other pesticides, are very toxic to man and should be handled carefully because they can contaminate the body, atmosphere, biosphere, and other living things.

According to Pidwirny (2002), there have been many reports of small pesticide residues in various foods. He also reported that, over the last 50 years many human illnesses and deaths have occurred as a result of pesticide contamination (up to 20,000 deaths per year). These are mostly due to accidental exposure of farm workers to pesticides. Accidental exposure may result from improper handling, or the non-use of protective clothing when applying pesticides.

He emphasised that, one potentially very harmful effect of pesticide use is the ability of pesticides to interfere with the endocrine system (which produces hormones) and the immune system of both animals and humans. The concentration of pesticides required to cause this type of damage can be very small, leading to increasing concerns involving pesticide use. Almost all pesticides can be fatal if present in large enough quantities, but organophosphates are found to be the most harmful and toxic. Small amounts of chlorinated hydrocarbons have been found to be present in the body fat of humans. The main source of this is contaminated food. Long-term effects of pesticide exposure can lead to cancer, mutations and congenital defects.

It is also reported that up to 90 % of the pesticides applied never reach the intended targets (Pidwirny, 2002). As a result, many other organisms sharing the same environment as the pests are accidentally poisoned. Human pesticide poisonings are clearly the most important. Therefore the CHTP also emphasises the use of appropriate dosages and protective clothing so as to minimize the adverse effects on humans and the environment.

Harvesting, Fermentation and Drying Technologies of Cocoa

Timely harvesting is very important for higher yield and good quality of cocoa beans. Harvesting is done every there (3) weeks once the pods begin to ripe. After harvesting, pods are opened after five days. Takrama (2006) reported that heap fermentation is practised in Ghana and it is the most suitable for cocoa fermentation. Though the recommended fermentation period is 6-7 days after opening and turning of the beans in heap at 48 and 96 hours interval, most farmers still use 3-5 days fermentation period. This is despite the fact that most farmers are aware of the appropriate recommendation (Takrama, 2006).

It is expected that if farmers follow the recommended practices under the CHTP, they would get ten (10) or more bags of cocoa beans per acre as compared to 3-5 bags of cocoa beans for farmers who do not the apply CHTP (Appiah, 2004a).

Impact Assessment of Programmes

According to Omoto (2004), impact refers to the broad, long-term economic, social and environmental effects resulting from research. Such

effects may be anticipated or unanticipated, and positive or negative, at the level of the individual or the organisation. Such effects generally involve changes in both cognition and behaviour. Evaluation is the judging, appraising, or determining the worth, value or quality of research, in terms of its relevance, effectiveness, efficiency, and impact.

Broadly speaking there are two main categories of evaluation: formative and summative. Formative evaluation is conducted during the operation of a programme to provide programme directors evaluative information useful to in improving programmes (Germanov, Meijer-Irons & Carver, 2004). According to Germanov et al. (2004), summative evaluation is devoted to assessing projects' success and it takes place after the project cycle has been completed. Summative evaluation, therefore, answers basic questions such as:

- Was the project successful? What were its strengths and weaknesses?
- Did the participants benefit from the project? If so, how and in what ways?
- What project component(s) was/were most effective?
- Was the result worth the cost?
- Can the project be replicated?

Mosley and Hulme (1998) identified specific areas that may be looked at in summative evaluation. These include agriculture, research and development, health, nutrition, reproduction, child schooling, income, employment, impact on poverty, women, empowerment and sometimes domestic violence.

Agricultural research generates many types of outputs. These include technologies embodied in a physical object (e.g., improved seeds), management tools and practices, information, and improved human resources. These outputs affect the environment of research institutes (through training and partnership building) and research clientele (through technologies and information generated), which ultimately impact the indicators of research goals.

The term "impact evaluation" and "impact assessment" are used interchangeably. Bennett (1979, p. 2) defines impact evaluation as the "assessment of a programme's effectiveness in achieving its ultimate objectives or assessment of relative effectives of two or more programmes in meeting common ultimate objectives". Impact evaluation, according to Baker (2000), is intended to determine more broadly whether the programme had the desired effects on individuals, households, and institutions and whether those effects are attributable to the programme intervention. He asserted that impact evaluations can also explore unintended consequences, whether positive or negative, on beneficiaries. Germanov et al. (2004) agreed with Baker (2000) that an honest evaluation recognises unanticipated outcomes, both positive and negative, that come to light as the result of a programme. Baker (2000) further stated that impact evaluation answers important questions such as:

- 1. How did the project or programme affect the beneficiaries?
- Were any improvements a direct result of the project, or would they have improved anyway?
- Could programme design be modified to improve impact?
- Were the costs justified?

These questions cannot, however, be simply measured by the outcome of a project. There may be other factors or events that are correlated with the outcomes but are not caused by the project or programme.

Therefore, Baker (2000), emphasised that to ensure methodological rigour, an impact evaluation must estimate the counterfactual, that is, what would have happened had the project never taken place or what otherwise would have been true. Another concern is that counterfactuals themselves can be quite tricky because their conditions could also be affected by history, selection bias and contamination-threats to internal validity.

Types of Impact Assessment

Broadly speaking, there are three main categories of impact that form part of a comprehensive impact assessment namely, the assessment of direct outcomes of the research activities, the intermediate impact and people-level impact (Anandajayasekeram, Martella and Rukuni, 1996; Anandajayasekeram and Martella, 1999). Whereas intermediate impact is concerned with the organisational strategies and methods used by researchers and other actors in conducting more effective technology development and transfer people-level impact refers to the effect of the technology on the ultimate users or target group for which the technology was developed and it can be economic, socio-economic, socio-cultural, and/or environmental impact of a research or a programme.

Germanov et al. (2004) also classified impact assessment into two based on the needs of various stakeholders and that these identified needs help define the tools to be used and assessments that should be performed. These

are: donor-led and practitioner-led impact assessment. A donor-led impact assessment examines the impact of a project from the perspective of the lender. Donors always want to know some evidence that their money is being used to effectively further their organisational goals and the outcome of such assessment are shared with the donor's funders. The practitioner-led impact assessment, on the other hand, focuses more on how the assessment fits into existing work patterns, builds on existing knowledge and experience and produces results that can be easily used in management. The primary aim of donor-led impact is to measure, as accurately as possible, the impacts of interventions while that of practitioner-led impact assessment is to understand the processes of interventions and their impacts so as to improve those processes (Mosley and Hulme, 1998). Therefore, donor-led impact assessment is meant to 'prove impacts' whereas practitioner-led impact is meant to 'improve practice'.

Levels of Impact of Research and Development

In the context of Research and Development (R&D) activities, the term 'impact' is measured at two levels: the direct product of research and the people level impact (Omoto, 2004). The people level-impact begins to occur when there is a behavioural change among the potential users. It deals with the actual adoption of the research output and subsequent effects on, say, production, income and environment. In fact, these people level impacts correspond with the higher level indicators of Bennett's Hierarchy of Evidence (Bennett, 1979). Again, the people-level impact of any R&D programmes cannot be achieved without accomplishing the intended direct product of

research. Hence, in any comprehensive impact assessment, there is a need to differentiate between the research results and the contribution of the research results to development, and both aspects should be addressed simultaneously.

The purpose of impact assessments of agricultural research activities depends on when the assessment is done. Impact assessments can be undertaken before initiating the research (ex-ante) or after the completion of the research activity (ex-post) including the technology transfer (Evenson, 1997). The purpose of conducting preliminary assessments before undertaking research is to assist research managers in planning and priority setting. Specifically, to study the specific economic impact of a proposed research programme, to formulate research priorities by examining the relative expected benefits of different research programmes, and to identify the optimal combination of activities for the research programme. Similarly, there are several reasons for conducting the assessment after completion of the research programme. These include, studying the impact in terms of both direct products of research and people level impact, to provide feed-back to the scientists and the system including policy makers, for accountability purposes including establishing the credibility of the public sector research, and as justification for increased allocation of research resources (Evenson, 1997).

The most commonly used approach for assessing the direct product of research is known as effectiveness analysis (Omoto, 2004). A useful starting point for effectiveness analysis is the logical framework of the project. The logical framework permits the assessment of the degree to which the research activities have made changes in the desired direction. The logical framework

is a simple matrix that provides a structure which helps to specify the components of a programme/activity and the logical linkages between the set of means (inputs and activities) and the set of ends (outputs). This logical framework makes the impact assessment process transparent by explicitly stating the underlying assumptions and the risks associated with the analysis (Omoto, 2004).

Effectiveness analysis is a simple comparison of the projected targets to actual or observed performance of the project. Three sets of comparisons are identified in the literature: "before" and "after" comparison (also called historical comparison), "with" and "without" comparison, and "target" versus "achieved" comparison. The most useful comparison appears to be "target" versus "achieved". The targets need not be completely achieved for the project to be deemed effective. Hence, any movement in the direction of the desired target is evidence of project effectiveness.

Impact of Intermediate Product(s)

Intermediate impact is concerned with the organisational strategies and methods used by researchers, and other actors in conducting more effective technology development and transfer (Anandajayasekeram et al., 1996).

The link between the intermediate product and the ultimate economic benefit is not clear, and therefore, tends to be ignored in most impact assessment studies (Anandajayasekeram et al., 1996). The evaluation of intermediate products is made difficult by the fact that the benefits of these products are not easy to quantify. Thus, most studies acknowledge the fact that having the institutional capacity development is of paramount importance.

These studies, however, do not include the benefits in the assessment of the impact. The costs that are easy to quantify are usually included. Thus, the assessment of the intermediate product has been a tricky issue (Anandajayasekeram et al., 1996). The practice has been to trace the changes in institutional capacity over time using either simple trend analysis or comparisons. This requires baseline information on these indicators and careful monitoring.

Economic Impact

Economic impact measures the combined production and income effects associated with a set of R&D activities. The economic impact can be assessed through what is known as an "efficiency analysis", which compares the cost and the benefits of the project in a systematic manner (Anandajayasekeram et al., 1996). The economic impact assessment studies range in scope and depth of evaluation from partial impact studies to comprehensive assessment of economic impacts. One popular type of partial impact assessment is adoption studies that look at the effects of new technology such as the spread of modern crop varieties on farm productivity and farmers' welfare. Economic impact assessments of the more comprehensive type look beyond mere yield and crop intensities to the wider economic effects of the adoption of new technology (Anandajayasekeram et al., 1996).

These studies generally estimate the economic benefits produced by research in relation to associated costs and estimate a rate of return to research investments. Economic studies include studies that estimate economic benefits and measure economic rates of return. The literature on economic impact

studies also includes a wide range of levels of impact analysis, from aggregate, national level to programme and project level. The econometric approach of estimating research productivity and the total factor productivity analysis are best suited at the very aggregate-level of impact assessment. In assessing the economic impacts, research is treated as an investment, and rates of return (RoR) are then estimated for this investment. Rate of returns summarises the benefits and costs, and net income from the activity in a single number which can be easily compared with the cost of obtaining funds or rates of return obtained from alternative investments.

Basic Concepts Underlying Impact Studies of Agricultural Research and Development (R & D)

According to Evenson (1997), there are two basic concepts underlying impact studies of agricultural research and development. These are:

- Awareness-Knowledge-Adoption-Productivity (AKAP) sequence.
- The widening gap in interrelations among extension, training and research.

These concepts basically focus on the changes in technology (new varieties or breeds), management technology (husbandry practices), management of scarce resources, (capital, Know-how), farming systems and relations with the external context (e.g., cooperative sales of produce).

According to Evanson (1997), AKAP sequence is frequently used to visualise the process of agricultural extension such as:

- Farmers getting aware.
- Farmers getting to know by probing and try-out.

- Adoption of technology or practice by farmers.
- Productivity changes at farm level.

The widening gap concept, on the other hand, focuses on the gap between yield, and extension and research activities. Lunning (1999) reviewed impact studies of the works of Bindlish, Gbetibouo and Evenson (1993); Birkhaeuser, Evenson and Feder (1991); Bindlish and Evenson (1993); Mutoro (1997) and Mutimba (1997) all done in Africa, and they showed that the impact of extension on farmers' yield depended on the situation and the method used in assessing the effectiveness or impact. While those done by Mutoro (1997) and Mutimba (1997) in Kenya and Zimbabwe respectively showed a big gap between yield and extension (that is to say the potential contribution of agricultural extension is very low); those done by Bindlish, Gbetibouo and Evenson (1993), and Bindlish and Evenson (1993) in Burkina Faso and Kenya respectively showed significant contribution of extension (i.e small gap between yield and extension).

Studies that showed significant improvement applied a "one-visit survey" evaluation method and participatory observation by villages while those that resulted in big gap between yield and extension applied the "with and without" evaluation method and econometric approach (cost-benefit analysis).

Criteria for Evaluating Impact of Programmes

Bennett (1979) identified seven (7) broad categories of criteria which are useful in formally evaluating the impact of programmes with particular reference to Agricultural Extension, and provided guidance in choosing

evidence regarding these categories. These seven broad criteria were linked with what he termed "chain of events" that were assumed to characterise extension education programmes. Thus, he viewed extension programmes in terms of seven levels of objectives and evaluative evidence. These are Inputs, Activities, People Involvement, Reactions, KASA Change (Knowledge, Attitudes, Skills and Aspiration), Practice Change and End Results levels. According to Bennett (1979), the Level 1 and 2 are characterised by extension effort, Level 3 includes the people involvement by extension staff and the nature of their involvement, and Levels 4 through 7 cover the responses by these people and target groups.

Selection of Level of Evidence

A number of guidelines are given by Bennett (1979) for the selection of evidence for measuring performance based on experience and logical plausibility. For example, one of such guideline is that "evidence of programme impact becomes stronger as the level or hierarchy is ascended". However, he noted, "the difficulty and cost of obtaining evidence on a programme accomplishment generally increases as the hierarchy is ascended" (Bennett, 1979, p. 7). Hence, evidence at the two lowest levels (Input and Activities) provides little or no measure of the extent to which clientele benefits from a programme but at the Level 7 (end results) the level of impact is highest and can give us enough evidence as to the extent clientele benefit from the programme.

Though evidence from the lower levels of the hierarchy provides little indication of impact, it is comparatively inexpensive and easy to obtain. As the

hierarchy is ascended, the cost and resources needed to measure actual programme outcomes generally increase and it is highest at End Results level. Another guideline provided by Bennett (1979, p. 8) was that "impacts are strengthened when several levels of the hierarchy including the inputs level are assessed".

Another important guideline provided is the use of proxy measures. Proxy measures are based on research-tested relationships between achievement of objectives at the lower and higher level of objectives. Inferences can be made at higher levels of the hierarchy (say at the KASA change) when evidence of programme impact are collected at the lower level of the hierarchy (say at the Activities level). Proxy measures ensure efficiency since evidence from lower levels is less costly and scarcely measures impact but proxy measures could be used to predict or infer higher levels of evidence which gives greater evidence of impact of a programme. Despite the advantage of proxy measures, it is emphasised that "caution must be exercised as to how far previous research can be generalised as a basis for assessing programme effectiveness" (Bennett, 1979, p. 15). It is very important to involve stakeholders in identifying criteria for measuring impact of a programme (PRMPR and SVD World Bank, 2003).

Designs for Identifying Sources of Impact

Study designs suggest schemes for collecting evidence of programme impact. They vary in strength of scientific evidence regarding the extent to which KASA change, practice change and end results are brought about by a programme rather than through other sources of change. Bennett (1979)

described six (6) designs used in impact studies namely, the field experiment, matched set design, time-trend study, before and after study, the survey and the case study.

The "Field Experiment", also known as randomization, is generally considered the most robust of the evaluation methodologies (Baker, 2000). By randomly allocating the intervention among eligible beneficiaries, the assignment process itself creates comparable treatment and control groups that are statistically equivalent to one another, given appropriate sample sizes. This is a very powerful outcome because, in theory, the control groups generated through random assignment serve as a perfect counterfactual, free from the troublesome selection bias issues that exist in other evaluation methods. The main benefit of this technique is the simplicity in interpreting results - the programme impact of the outcome being evaluated can be measured by the difference between the means of the samples of the treatment group and the control group. The main disadvantages of the experimental design, according to Bennett (1979) and Baker (2000), are complexity of cost and undesirable ethical or political considerations.

The "Matched Set Design" is similar to the field experiment except that it does not assign potential audience randomly. Hence programme group (set) and a comparison group are selected on the basis of their similarity, rather than randomization, which is in the case of Field Experiment. The basic limitation of this design, according to Bennett (1979), is that it is partial and incomplete because it is not able to identify accurately the programme's contribution to change as compared to other sources of change.

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"Time-Trend Studies" monitor participants' KASA change, practice change and problem solution over a number of years. Therefore, programme impact is identified as the difference between observed programme after conditions and projected conditions based on rate of change from time to time. This design is considered appropriate when there is a trend that seems likely to have continued if the programme had not been introduced.

"Before and After Studies" compare observations before and after a programme or project implementation. They test partially the extent to which any change at higher levels of the hierarchy in the Bennett's Model is as a result of the programme or project of interest.

The "Survey Design" measures the perceptions or opinions about activities and outcomes of a programme. It compares the effect of a programme between participants and non-participants or compares at one point in time achievements of programme objectives. The main limitation of the survey is that, because it lacks situational data prior to programme implementation, it generally provides weak conclusions about the extent to which a programme, rather than other forces, produces any observed differences between participants and non participants (Bennett, 1979). However, the survey has the following advantages: it requires fewer resources (time, participants and money) than other designs such as experimental, matched set time-trend and the before-after studies. It is also simple and flexible. Furthermore, it makes it possible to evaluate a programme or project that has been implemented but data had not been collected about situations or status prior to implementation - a condition which is a prerequisite for other designs.

The "Case Study" observes intensively one or only few selected individuals or groups. It provides weak scientific evidence of programme's impact at the community, state or national level because:

- Even if data on each case is valid, the cases may not be a representative of programme clientele.
- The question of how much progress participants and potential participants would probably have made without the intervention is usually not answered satisfactorily.

Table 1: Characteristics of Designs for Analysing Impacts of Extension Programmes

Evaluation Design	Observations			Comparison Set		Evidence can be apply broadly
	Before	During	After	Used	RA*	
Field Experiment	May be	Yes	Yes	Yes	Yes	Yes
Matched Set	Yes	Yes	Yes	Yes	No	Yes
Time Trend	Yes	Yes	Yes	No	-	Yes
Before and After	Yes	Yes	Yes	No	-	Yes
Survey	No	May be	Yes	May be	-	Yes
Case Study	May be	May be	Yes	No	-	May be

Source: Bennett (1979, p.20). *RA= Randomly Assigned

However, the case study can draw together many diverse pieces of information into unified interpretation and may provide important evaluative insights - provides leads regarding the conduct and interpretation of studies

that use more definitive designs. Table 1 shows a summary of characteristics of designs for analysing impacts of extension programmes discussed by Bennett (1979).

Qualitative and Participatory Methods

According to Baker (2000), qualitative and participatory techniques often provide critical insights into beneficiaries' perspectives, the value of programmes to beneficiaries, the processes that may have affected outcomes, and a deeper interpretation of results observed in quantitative analysis. Mohr (1995) pointed out that qualitative techniques are also used for carrying out impact evaluation with the intent to determine impact by the reliance on something other than the counterfactual to make a causal inference. The focus instead is on understanding processes, behaviours, and conditions as they are perceived by the individuals or groups being studied.

However, Baker (2000) contends that because measuring the counterfactual is at the core of impact analysis techniques, qualitative designs have generally been used in conjunction with other evaluation techniques. The qualitative approach uses relatively open-ended methods during design, collection of data, and analysis. It is noteworthy to state that qualitative data can also be quantified. Among the methodologies used in qualitative impact assessments are the techniques developed for rapid rural assessment, which rely on participants' knowledge of the conditions surrounding the project or programme being evaluated.

Among the benefits of qualitative assessments according to Baker (2000) are that they:

- are flexible,
- can be specifically tailored to the needs of the evaluation using open-ended approaches,
- can be carried out quickly using rapid techniques, and
- can greatly enhance the findings of an impact evaluation through providing a better understanding of stakeholders' perceptions and priorities and the conditions and processes that may have affected programme impact.

The main drawbacks are:

- the subjectivity involved in data collection,
- the lack of a comparison group, and
- the lack of statistical robustness, given mainly small sample sizes.

The above enumerated drawbacks make it difficult to generalise to a larger, representative population. The validity and reliability of qualitative data are highly dependent on the methodological skill, sensitivity, and training of the evaluator. If field staff are not sensitive to specific social and cultural norms and practices, and nonverbal messages, the data collected may be misinterpreted. Finally, without a comparison group, it is impossible to determine the counterfactual and thus causality of project impact (Baker, 2000).

It should also be noted that integration of quantitative and qualitative methods or approaches is suggested to be the best way of impact assessment since it takes advantage of the merits of both approaches Bamberger (2000)

gave numerous benefits of integrated approaches and among them are the following:

- Building of consistency checks through the use of triangulation procedures that permit two or more independent estimates to be made for key variables (such as income, opinions about projects, reasons for using or not using public services, and specific impact of a project).
- Obtaining data from different perspectives. For example, although researchers may consider income or consumption to be the key indicators of household welfare, case studies may reveal that women are more concerned about vulnerability (defined as the lack of access to social support systems in times of crises), powerlessness, or exposure to violence.
- Analysis can be conducted on different levels. Survey methods can provide good estimates of individual, household, and community level welfare, but they are much less effective for analyzing social processes (social conflict, reasons for using or not using services, and so on) or for institutional analysis (how effectively health, education, credit, and other services operate and how they are perceived by the community). There are many qualitative methods designed to analyze issues such as social processes, institutional behaviour, social structure, and conflict, and
- Provision for feedback opportunities to help interpret findings.

The Sustainable Rural Livelihood (SRL) Framework

Livelihoods have been defined as the assets, activities, and access determining the living gain by individuals or households (Ellis, 1998; 1999). Scoones (1998) identified three (3) broad livelihood strategies: intensification or extensification of existing productive activity, diversification by adopting additional productive activities and migration to develop productive activity elsewhere. The Sustainable Rural Livelihoods (SRL) framework is the most recent development approach to the analysis of links between livelihoods and natural resource use which has been widely discussed in recent years (Scoones, 1998; Carney, 1998; Ellis, 1999). Its central idea is that sustainability of livelihood strategies of individuals or households depends on access to, use, and development of different types of assets (Woodhouse, Howlett, Bond, and Rigby, 2000a; Woodhouse, Howlett, and Rigby, 2000b).

The purpose of this framework, according to Woodhouse et al. (2000a), is to provide a simple, quick, and easily understood assessment of the status of access, endowment and/or utilisation of the different capitals based on local understanding and perceptions of stakeholders in the system. This is very important because, according to Brokensha, Warren and Werner (1980), the separate worlds of modern scientific knowledge and indigenous knowledge systems are increasingly seen as valid components in rural enquiry. Moreover, Bond, Kapondamgaga and Ragubendra (2003), pointed out that the modern scientific knowledge and indigenous knowledge do not have to compete, but rather can complement each other. Therefore, all stakeholders must be considered in developing the frameworks for measuring livelihoods.

Elements of the Sustainable Rural Livelihood (SRL) Framework

The framework is based on the five capitals of the sustainable livelihoods framework and describes the low and high status in access, use and/or endowment of the five capitals as defined in locally understood terms and perceptions. The framework was adapted from the method of "Quality of Life Assessment" described by (Bond and Hulme, 1992). The five basic types of capital that comprise assets for livelihoods described by Scoones (1998); Carney (1998), Ellis (1999), Woodhouse et al. (2000a) and Woodhouse et al. (2000b), are natural, physical, financial, human, and social.

For each capital, a different range of word pictures, scenarios or indicators are determined by the relevant stakeholders to represent the best and worst scenarios in their view. The framework is then used to assist in the interpretation of local criteria of success, the identification of local indicators and to assess the success of the systems from the perspective of different stakeholders and also the information can be used to compare between different systems and the status of different groups within the same system. Further, the framework considers assets as stocks of different types of 'capital' that can be used directly or indirectly to generate livelihoods and these can give rise to a flow of outputs possibly becoming depleted as a consequence, or may be accumulated as a surplus to be invested in future productive activities.

Natural capital consists of land, water, and biological resources such as trees, pasture, and wildlife. The productivity of these resources may be degraded or improved by human management. Indicators of natural capital assets for livelihoods include:

- Access to land, water, grazing,

- Ownership of herds of cattle, sheep, goat and trees,
- Productivity (per unit of land, per unit of water, per unit of inputs),
- Soil, water, rangeland, quality, and
- Biodiversity.

Physical capital is that created by economic production. It includes infrastructure such as roads, irrigation works, electricity supply, and reticulated water, and also producer goods such as machinery. Indicators include:

- Access to roads, electricity, piped water,
- Ownership/access to productive equipment (oxen, tractor , irrigation pump, etc.), and
- Housing quality.

Human capital is constituted by the quantity and quality of labour available. At household level, therefore, it is determined by

- Household size and
- Education, skills, and health of household members.

Financial capital consists of stocks of money or other savings in liquid form. In this sense it not only includes financial assets such as pension rights, but also includes easily-disposed assets such as livestock, which in other senses may be considered as natural capital. The indicators are:

- Income levels, variability over time, distribution within society,
- Financial savings,
- Access to credit, and
- Debt levels.

Social capital includes any assets such as rights or claims that are derived from membership of a group. This includes the ability to call on friends or kin for help in times of need, support from trade or professional associations (e.g. farmers' associations), and political claims on chiefs or politicians to provide assistance. Indicators include:

- Membership of organizations,
- Support from kin, friends, and
- Accountability of elected and appointed representatives.

In summary, the Sustainable Rural Livelihood Framework has become established as an influential model for the conceptualisation of rural people's livelihoods and has been adopted by many programmes and projects, particularly those under the DfID sphere of influence (Bond, Kapondamgaga, and Ragubendra, 2003). At the heart of this model is the concept of a 'livelihood platform' of five capital assets which households access and utilise for their diverse livelihood strategies and which provide the sustainability to those livelihoods.

Perception as a Process

Perception has been defined by many scholars in different ways. According to Van den Ban and Hawkins (1996), perception is the process by which we receive information or stimuli from our environment and transform it into psychological awareness. Gamble and Gamble (2002) also define perception as a process of selecting, organising, subjectively interpreting sensory data in a way that enables us to make sense of our world. From the aforementioned definitions it could be deduced that perception, as a process,

involves the use of the senses to interpret the 'world' or the environment. However, Gamble and Gamble (2002), pointed out that perception involves more than the use of the senses alone. They epitomized perception as the "I" behind the senses, that is, what occurs in the real world may be quite 'poles apart' from what is perceived to occur. In other words, the interpretation of events may differ markedly from the actual events among different people.

General Principles of Perception

Perception is said to be governed by general principles such as: relativity, selectivity, organisations, direction, and cognitive style (Van den Ban and Hawkins, 1996).

Relativity

Van den Ban and Hawkins (1996) claimed that our perceptions are relative rather than absolute. Although we are not able to judge the exact weight or surface area of an object, we may be able to tell whether it is heavier or lighter, or larger or smaller than another similar object. Hence, when designing messages, we should remember that a person's perception of any part of the message will depend on the segment immediately preceding it. Perception of a message also will be influenced by its surroundings.

Selectivity

Van den Ban and Hawkins (1996) asserted that our perceptions are very selective. At any moment, our senses are receiving a veritable flood of

stimuli from the environment around us. Despite its capacity to process vast amount of information, our nervous system cannot make sense of all the stimuli available. Hence, individuals pay attention only to a selection of those stimuli.

Gamble and Gamble (2002) also said that individuals select only those experiences that re-enforces existing attitudes, beliefs and values and tend to ignore or diminish the significance of those experiences that are inconsistent or dissonant with their existing attitudes, beliefs and values. Past experience and training influence our selectivity of perception. Training can provide an organised and structured set of experiences to influence our perceptions.

Organisations

Van den Ban and Hawkins (1996) further argue that our perceptions are organised, that is, we tend to structure our sensory experiences in a way, which make sense to us. In a fraction of a second, our senses sort our visual and aural stimuli into figures, which stand out from a background. A good 'figure' attracts attention, so a designer may wish to incorporate it in a specific part of a message. Another characteristic of perceptual organisation is termed 'closure' (the perceiver tends to close or complete what he or she perceives to be an open or incomplete figure).

Direction

We perceive what we expect or are 'set' to perceive. Our mental set influences what we select and how we organise and interpret it. "Set" is an important perceptual concept, which can be used by the communication

designer to reduce the number of alternative interpretations, given to stimulus. Van den Ban and Hawkins (1996) also noted that perceptual set might be a major deterrent when communicators want their audience to view or interpret a situation in a new way.

According to Gamble and Gamble (2002), perceptual set is affected by age, motivation, past experience and educational level. The authors, however, emphasised that age alone does not determine the part played by experience and that even among people of the same age, past experiences differ and hence affect the way stimuli are perceived. In the case of education, they asserted that at times, it can become a barrier rather than a facilitator or aid to communication. It is then concluded that lessons that life has taught an individual necessarily differ from those life has taught others. As a result, people can perceive the same stimulus differently.

Cognitive Style

An individual's perception will differ markedly from another's in the same situation because of different cognitive style (Van den Ban and Hawkins, 1996). Our individual mental processes work in distinctly different ways depending on personality factors such as our tolerance for ambiguity, degree of open and close mindedness and authoritarianism. Clearly, it is impractical to design different messages, which take into account all combinations of cognitive styles among our audiences. Hence, it is recommended that one should adopt a strategy by which the same idea is presented in a number of different ways, which will appeal to most cognitive styles. This Van den Ban and Hawkins (1996) termed as message redundancy.

Demographic and Farm Related Characteristics of Farmers

The main demographic factors that this study focused on are sex, age, education background, years of experience, and household size of farmers. The study also examined some farm-related features, namely, number of farms, size of farms, age of cocoa tree and yield. Such factors may predispose a farmer to take an interest in a new technology.

Sex of Farmers

Nelson (1981) stated that it is wrong to assume that an effective development programme for males will automatically translate into an effective programme for women, as well. This implies that men and women have different needs and desires. Gamble and Gamble (2002) asserted that men and women perceive different realities, have different expectations set for them, and that while women are typified as emotional, men are classified as rational.

A survey undertaken by CRIG in 1995 in the Ashanti Region of Ghana revealed that there were 71% male and 29% female cocoa farmers. Dankwa (2002) conducted a survey in Ashanti Region in 2000 and reported that out of 160 cocoa farmers interviewed, 135 (84.4%) were males and 25 (15.6%) females. However, a survey conducted by Kumi (2003) in the Kwaebibrem District in the Eastern Region revealed that 55% were males and 45% females. These gave some indication that, cocoa farming is not a preserve of males.

Age of Farmers

Studies have shown that average age of farmers in the farming communities in Ghana is between 50 and 60 years, or majority of farmers are over 50 years (La-Anyane, 1985; Dankwa, 2002). Health of individuals normally declines with old age and, therefore, affects the work a farmer can do and consequently productivity.

Educational Level of Farmers

Education enhances one's ability to receive, decode, and understand information and that information processing and interpretation are important for performing many jobs (Byrness and Byrness, 1978). The authors claimed that farmer's level of education, to some extent, determines the type of tasks he can undertake in any programme, and therefore the type and level of participation. However, Gamble and Gamble (2002), emphasised that at times, high level of education can become a barrier rather than a facilitator or aid to communication.

Data from four (4) rounds of household surveys suggest that individuals resident in urban areas were much more likely to have attended school than in rural areas in Ghana (Aryeetey, 2004). In the rural areas where majority are farmers, only 29.3% of the sample had attended school in 1992. Aryeetey (2004) observed that only 32% of the rural sample could read and only 30% could write while 41% could do simple calculations. In related studies in Ashanti and Eastern Regions of Ghana, about 50 - 55% of cocoa farmers have been found to have no formal education (Dankwa, 2002; Kumi, 2003).

Years of Experience of Farmers

Dankwa (2000) found out in his survey that the majority (80.7%) of the farmers had worked between 10 and 40 years with an average experience of 23 years. The considerable amount of experience may foster adoption of cocoa technologies if socio-economic problems are addressed.

Household Size of Farmers

Aryeetey (2004) reported that average household size in rural forest in Ghana was 6.9 and 7.51 in the rural Savannah area. According to Asante-Mensah (1988), the majority of farmers (60%) have medium-size households with 7-15 members. Just over 20 per cent had small households. Respondents with large or very large households made up the remaining 18 per cent.

A child labour survey conducted by the International Institute of Tropical Agriculture (IITA, 2002) in four (4) West Africa countries (Cameroon, Côte d'Ivoire, Ghana, and Nigeria) concluded that children in rural areas have traditionally worked in agriculture as part of the family or household unit. Family labour was found to be most used labour type. In Côte d'Ivoire, for example, 87 percent of the permanent labour used in cocoa farming came from the family or the household. The study also revealed that in cocoa farming, children, who form the major part of the household, engaged in a number of tasks/activities such as clearing fields, weeding, maintaining cocoa trees, applying pesticides, fermenting, and transporting, drying, and other tasks.

The implication is that the size of a household can affect the adoption of cocoa technologies especially if the technology is labour-intensive or involves the aforementioned activities.

Number and Size of Farms

Most farmers in Ghana have small holdings and produce crops using traditional methods and low technologies. Edwin and Masters (2003) reported that all the 123 farmers that they sampled for their survey in Ashanti and Western regions had between 1 to 3 cocoa farms.

It is estimated that about 31% of the farm holdings are less than 1.6ha while only 18% are more than 4.0ha per farmer in Ghana (MoFA, 2003). Edwin and Masters (2003) also found from their survey that the average land size of cocoa farmers was 3.50 ha (8.8 acres).

Yield and Age of Cocoa Tree

It is estimated that there are approximately 500,000 cocoa farmers in Ghana who produce an average of 550,000 metric tonnes of cocoa annually (Takrama, 2006). Appiah (2004a) also noted that average national annual yield in Ghana is 350 kg/ha or 140 kg/acre. HTA (2002) reported that the average yield of cocoa farmers in Ghana was 207 kg/ha. Edwin and Masters (2003) also reported that the average yield of farmers in Ashanti and Western regions was 294.8 kg/ha. However, they reported an average of 258 kg/ha and 497 kg/ha for traditional and hybrid varieties respectively indicating that yield of hybrid is approximately twice that of the traditional variety.

Edwin and Masters (2003) reported further that in 2002, the tree age in Ashanti and Western regions affected the yield of cocoa plants and that yields declined mainly at higher levels of age of cocoa even when fertiliser was applied. They found out that yields of cocoa farms were highest when trees were between 8 to 15 years old for both hybrids and traditional varieties and declines with age even when fertiliser was applied. They also reported that of the 192 farms surveyed, the average age of plantings or cocoa trees was 20 years with a minimum and a maximum 3 and 56 years respectively.

CHAPTER THREE

METHODOLOGY

General Overview

This chapter describes the procedures and techniques used to collect and analyse data for the study. It captures the design, the population, the sample size, the sampling procedure, the research instrument, data collection and data processing and analysis that were used as well as the rational behind choosing these techniques for the study.

Research Design

A descriptive-correlational survey design was used for the study. According to Neuman (2003), survey designs systematically ask many people the same questions about situation of programme or project. Researchers who employ survey design measure many variables, test multiple hypotheses and infer temporal order about past behaviour, experience, or characteristics. Surveys also generally gather data from a relatively large number of cases at a particular time (Best and Kahn, 1998). Bennett (1979, p. 3) also pointed out that surveys in programme evaluation or impact studies "generally compare at one point in time the achievements of programme objectives or may compare the effect of a programme between participants and non participants".

An important use of the survey in impact studies is to collect data on perceptions or opinions about the activities or outcomes of a programme or

project (Bennett, 1979). He emphasised that the survey requires fewer resources (time, participants and money) than other designs that are used in impact studies such as the experimental, matched-set, time-trend and the before-after studies. It is also simple and flexible. It also makes it possible to evaluate a programme or project that has been implemented but data was not collected about situations or status prior to implementation, a condition which is a prerequisite for other designs.

The researcher employed the correlational study design because he sought to explore relationship between dependent and independent variables as well as the best predictor (s) of the dependent variable from the independent variables of the of the study.

The Study Population

The population of the study was cocoa farmers in the Eastern Region of Ghana, who have benefited from or adopted the CHTP.

Sampling Procedures

A combination of simple random sampling and purposive sampling procedures were used for the study. Four (4) districts namely Birim South, East Akim, Fanteakwah and Birim North were randomly selected from the nine (9) main cocoa growing districts which undertook the CHTP in the Eastern Region of Ghana. The other five (5) districts were West Akim, Kwahu South, Suhum Kraboa Coaltar, New Juabeng and Kwaebibrem.

Purposive sampling was used to select cocoa farmers who have participated in the programme since its inception in 2003/2004 growing

season. This was to help the researcher measure effectively the impact on livelihoods since little impact might be seen on livelihoods of farmers who have just adopted the technology, i.e. a year or less (ECART / ASARECA / CTA, 1999; Omoto, 2004). Two hundred (200) cocoa farmers were then randomly selected from these farmers.

Sample Size

Researchers have given formulae and tables for estimating 'appropriate' sample size of a population given the confident intervals, level of precision and degree of variability in the attribute being measured (Israel, 1992). Generally, they agree that larger sample sizes are better than smaller sample size. In other words, the larger the sample size, the smaller the magnitude of sampling error and the greater the likelihood that the sample would be a representative of the population. However, they unanimously agree that the above assertion holds only when the sample is randomly chosen. According to Best and Kahn (1998, p. 17), "there is no fixed number or percentage of subjects that determines the size of an adequate sample" and argue that sample size may depend on the nature of the population, the data to be gathered, the type of analysis to be done and funds available for the study. They implied that a sample size of even less than 0.1% of a given population can be a reflection of the opinion of the population (with an error factor of 2% or 3%) if subjects are **randomly** selected.

A total of 200 cocoa farmers were randomly selected from the four (4) districts (in proportion to the number of farmers from each district as shown in Table 2. Stevens (1996) recommends that for social science research, about 15

subjects or cases per predictor are needed for a reliable equation in regression analysis. Tabachnick and Fidell (1996) also gave a formula for calculating sample size requirement in regression analysis taking into consideration the number of independent variables: n>50+8m (were n=sample size or number of cases and m = number of independent variables). Therefore, if there are five (5) independent variables more than 90 cases are needed for a reliable and generalisable prediction. However, Pallant (2001) stated that when stepwise regression is used, there should be a ratio of forty (40) cases or respondents for every independent variable. Two hundred (200) respondents were, therefore, chosen since the researcher employed stepwise multiple regression and also five (5) independent variables were used for the prediction. Table 2 shows the sample size taken from each of the four (4) districts.

Table 2: The Population and Sample Size used for the Study

District	Total Number of farmers*	Sample size selected
Birim South	2500	68
East Akim	1939	53
Fanteakwah	1399	38
Birim North	1518	41
Total	7356	200

*Source: MoFA, 2003.

Instrumentation

Structured and validated interview schedule was developed as an instrument for the study. Both face and content validity were ensured. Face validity was ensured by the researcher while content validity was checked by the supervisors, lecturers in the Department of Agricultural Economics and Extension University of Cape Coast and researchers at the Cocoa Research Institute of Ghana (CRIG).

The interview schedule consisted of three (3) main parts. Part one (1) measured the perceived effectiveness of the components of the CHTP. A five (5) point Likert-type scale (ranging from 'Very Effective' to 'Very Ineffective') was developed to measure respondents' perceptions on the level of effectiveness of each component of the programme. Part two (2) measured the level of perceived impact of the programme on various categories of respondents' livelihoods. A five point Likert-type scale (ranging from 'Very High' to 'Very Low') was developed to measure the perceived impact of the programme on respondents' livelihoods. Part three (3) considered the demographic and farm-related characteristics, namely sex, age, educational level, years of experience, household size, age of cocoa farm, size of farm and number of farms and yield of respondents. The structure of questions in the instrument was a combination of close-ended, open-ended and partially close-ended questions. Table 3 shows the Likert-type scales and their interpretations.

Table 3: Interpretations of Likert-type scales

Ratings	Interval	Perceived effectiveness of the CHTP	Perceived impact of the CHTP on livelihoods
5	4.45 – 5.00	Very Effective	Very High
4	3.45 – 4.44	Effective	High
3	2.45 – 3.44	Moderately Effective	Moderately High
2	1.45– 2.44	Ineffective	Low
1	1.00 – 1.44	Very Ineffective	Very Low

Source: Author's Construct, 2006.

Pilot Study

A pilot study was conducted in one of the remaining five (5) districts - Suhum Kraboa Coaltar. To ensure that respondents selected for the pilot study had homogenous characteristics with the cocoa farmers selected for the study, twenty (20) cocoa farmers, who adopted the programme at the beginning of the programme implementation in **2003** were selected and interviewed.

The pilot study was conducted to pre-test the instrument to determine its reliability. With the help of SPSS (Statistical Product and Service Solutions formerly Statistical Package for Social Sciences) version 12.0, Cronbach's alpha co-efficient was used to determine the internal consistency of all the Likert-type scales. The two main sub-scales: perceived effectiveness of the programme and perceived impact on livelihoods had Cronbach's alpha co-efficients of 0.87 and 0.79 respectively indicating that the instrument was reliable. This is because scales with Cronbach's alpha co-efficient of 0.70 or more are considered to be reliable (Pallant, 2001). Table 4 shows reliability

co-efficients of the two main subscales. The final structured interview schedule was developed for the collection of the main data. The pilot study was conducted in February 2006.

Table 4: Reliability Co-efficients of Subscales of the Research Instrument

Subscales	Number of Items	Cronbach's alpha
Perceived effectiveness of the CHTP	17	0.8686
Perceived impact of the CHTP on Livelihood	20	0.7936

n=20, Source: Field Data, 2006

Data Collection

Four (4) Agricultural Extension Agents (AEAs) were selected from each of the four (4) districts and trained on how to administer the instrument. Training encompassed the meaning and interpretation of each item on the interview schedule.

The validated and pre-tested structured interview schedule was translated into the local dialect of individual respondents and their responses ticked or written on the schedule. The data was collected between the first day of March, 2006 and first week of May, 2006 and by the mid of May 2006, all the 200 completed interview scheduled were received from the administrators. There was a100% response rate.

Data Analysis

With the help of Statistical Product and Service Solutions (SPSS version 12.0), frequencies, percentages, means, modes, standard deviations, independent sample t-test, dependent sample t-test, analysis of variance (ANOVA), Pearson product moment correlation coefficients and stepwise multiple regression were used to analyse the data. The analytical technique(s) used to analyse each of the specific objectives are as follows:

Objective one (1) was to find out perceptions of farmers on the effectiveness of the main components of the CHTP. Frequencies, percentages, means, weighted means and standard deviations were computed from respondents' responses to describe their perceived effectiveness of the programme.

Frequencies, percentages, means, weighted means and standard deviations were computed to analyse the Objective two (2), which was to examine the level of perceived impact of the CHTP on the livelihoods of the respondents.

Objective three (3), which compared the level of perceived impact of the programme on farmers' livelihoods among the four districts, was analysed using analysis of variance (ANOVA) to test significant differences among cocoa farmers perceived impact of the programme in the four (4) districts of the study area. Since the F-test showed significant difference, a post hoc multiple comparison technique was used to isolate where the differences existed among the mean perceived impacts on respondents in the four (4) districts. But before that the Levene's test of homogeneity of variance was used to determine whether equal variances existed among the means of the

four districts or not. It showed that equal variance was not assumed (i.e variances in the subgroups, i.e. districts are not homogeneous). There are hosts of post hoc multiple comparison tests that are recommended for use if variances are not homogeneous among subgroups (Backer, 1999; Gupta, 1999; Green and Salkind, 2000; Pallant, 2001). Tamhanes's T2 post hoc multiple comparison was chosen because it is recommended to be used if equal variances among groups are not assumed. Secondly, it is also recommended when group sizes (n) to be used are unequal and that was the case in the four (4) districts used for the study as indicated in Table 2 (Green and Salkind, 2000). Also, according to Green and Salkind (2000), Tamhanes's T2 is more conservative (like the Scheffe's test which is used when equal variance is assumed) in that it tests all possible combinations of the means. It is also "the most used test statistics by statisticians" (Gupta, 1999, p. 190).

Frequencies and percentages were used to describe the perception of farmers on the problems or weaknesses and strengths of the programme and how the programme may be improved as purported in the Objective four (4).

Means and standard deviations were used to describe mean perceived effectiveness of the programme of male and female farmers, whereas the independent sample t-test was used to determine whether significant difference existed between male and female cocoa farmers perceived level effectiveness of the programme as purported in Objective five (5).

Frequencies, percentages, means, modes and standard deviations were used to describe cocoa farmers' demographic and farm related characteristics as set out in Objective six (6).

Objective seven (7) was to compare the estimated yield of cocoa farmers before and after they adopted the programme. Means and standard deviations were used to describe the yield before and after the CHTP. Dependent (paired) sampled t-test was used to determine whether there had been any significant increases in yields as a result of the CHTP.

Pearson product moment correlation coefficient was used to analyse Objective eight (8), which was to explore the relationships between the farmers' perceived impact of CHTP on livelihoods and the level of perceived effectiveness of the main components of programme. Davis' Convention (Appendix 1) was used to describe the magnitude of all correlation coefficients because it is elaborate and widely used by most researchers (Miller, 2005).

Finally, stepwise multiple regression was used to identify the best predictor (s) of perceived impact of the programme on the livelihoods of farmers, from the perceived effectiveness of the main components of the programme as set out in objective nine (9).

All hypotheses or significant differences and relationships were tested using 0.05 alpha level. Table 5 summarises statistical tools that were used to analyse the data according to each specific objective.

The regression equation used for predicting the dependent variable (perceived impact on livelihoods) was:

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$$

Y = Perceived impact on livelihoods

a = Constant

$\beta_1 . \beta_5$ = beta coefficients of predictor variables

X_1= Cultural Maintenance

X_2 =Application of fertiliser

X_3 =Application of fungicides

X_4 =Application of insecticides

X_5 =Harvesting, fermentation and drying technologies.

Table 5: Summary of Statistical tools for analysing each objective

Specific objective	Statistical tools used for Analysis
One (1)	Frequencies, Percentages, Means, Weighted Means, Standard deviations
Two (2)	Frequencies, percentages, Means, Weighted means Standard deviations
Three (3)	Means, Weighted Means, Standard deviations, One way ANOVA, Levene's test of homogeneity of variance and Tamhanes's T2 Post Hoc Multiple Comparison
Four (4)	Frequencies and Percentages
Five (5)	Means and standard deviations, Independent sample t-test
Six (6)	Frequencies, Percentages, Means, Modes and Standard deviations.
Seven (7)	Means and standard deviations, Dependent(paired) sample t-test
Eight (8)	Pearson product moment correlation coefficient
Nine (9)	Stepwise multiple regression

Source: Author's Construct, 2006.

CHAPTER FOUR

RESULTS AND DISCUSSION

General Overview

This chapter presents and discusses the results of the study in relation to the specific objectives.

Perceived Effectiveness of the Main Components of the CHTP

Perceived effectiveness of Cultural Maintenance Component of the CHTP

The 'cultural maintenance component' of the programme generally prepares the cocoa trees and cocoa farm so that cocoa trees would make maximum use of the fertiliser when applied.

The results of the study revealed that at least over 82% of the respondents undertook each of the various sub-components of the cultural maintenance component of the CHTP, which included weeding of farm before fertiliser application, removal of basal chupons, overhead canopies, mistletoes and dead husks; removal of all cola, ceiba and oil palm trees from the cocoa farms and reducing the number of trees per acre (Table 6). For the digging of trenches in waterlogged areas, only fifteen (15) out of the 200 farmers, representing 7.5% of the respondents, said that their farms were susceptible to water logging and therefore dug trenches to drain the excess water during the rainy seasons. The frequencies and percentages of farmers, who undertook

each of the sub-components of the 'Cultural Maintenance Component' of the CHTP, are also presented in Table 6.

Table 6: Frequency Distribution of Respondents who Applied CHTP

	Yes		No	
Cultural Maintenance	f	%	f	%
Weeding of the cocoa farm before fertiliser application.	194	97.0	6	3.0
Removal of Basal Chupons, Overhead Canopies, and Mistletoes.	194	97.0	6	3.0
Removal of dead husks (Pod and Cherelles).	189	94.5	11	5.5
Removal of all Cola, Ceiba (onyina) and Oil Palm trees.	173	86.5	27	13.5
Leaving of about 8 trees per acre of the farm.	165	82.5	35	17.5
Digging of trenches (gutters) in the farm for drainage.	15	7.5	185*	92.5*

n=200. Source: Field Survey Data, 2006 * Not Applicable

Table 7 shows that 50.8% of 194 cocoa farmers who weeded their farm before they applied fertiliser perceived that it contributed effectively in increasing their yield. Only 1.5 % perceived that the above sub-component was ineffective. At least, two-thirds of the farmers who removed basal chupons, overhead canopies, and mistletoes from their cocoa trees, perceived

it to be 'effective' in increasing their yields. A substantial number of farmers (68) representing 35.1% perceived the practice to be 'moderately effective', that is, it was effective in increasing their yields but the increases in yields were below their expectations while only 6 (3.1%) respondents thought that it was 'ineffective' so far as its contribution to increasing their yields was concerned.

Table 7 also revealed that at least 60% of the respondents who undertook the various sub-components of the cultural maintenance component perceived that such activities have contributed effectively in increasing their yield and income with the exception of those who removed basal chopuns and dead husk (they had at least 56% perceiving it to be effective). A sizable percentage of farmers ranging from 27 to 38 percent perceived the various sub-components to be 'moderately effective' (i.e. contribution to yield was below their expectations though effective in increasing yield). Few farmers ranging from 1.5% to 4% thought that the various sub-components of the cultural maintenance were 'ineffective' and that did not result in increasing their cocoa yield. Ten (10) of the 15 farmers whose, farms were susceptible to water logging and, therefore, dug trenches on their farms to drain excess water perceived it to be very effective.

Table 7: Frequency Distribution of Respondents' Perceived Effectiveness of Cultural Maintenance Component of CHTP

Perceived effectiveness of cultural maintenance	VE		E		ME		IE		
	f	%	f	%	f	%	f	%	n
Weeding of the cocoa farm before fertiliser application.	42	23.7	72	37.1	73	37.6	3	1.5	194
Removal of basal chupons, overhead canopies, and mistletoes.	41	21.1	79	40.7	68	35.1	6	3.1	194
Removal of dead husks (pod and cherelles).	36	19.0	69	36.5	79	41.8	5	2.6	189
Removal of all cola, ceiba (onyina) and oil palm trees.	36	20.8	84	48.6	46	26.6	7	4.0	173
Leaving of 8 trees per acre of the farm.	30	18.2	70	42.4	59	35.8	6	3.6	165
Digging of trenches in the farm for drainage.	10	66.7	3	20.0	2	13.3	-	-	15

n=200. Source: Field Survey Data, 2006. VE= Very Effective, E=Effective; ME=Moderately Effective; IE=Ineffective, VI=Very Ineffective

Table 8 shows the mean perceived effectiveness of the various sub–components of the cultural maintenance component of the programme. Sub-components in the Table 8 are arranged in decreasing order of means of responses.

Table 8: Mean Perceived Effectiveness of the Cultural Maintenance Component of the CHTP

Cultural Maintenance	n	$\bar{X}$	SD
Digging of trenches (gutters) in the farm for drainage	15	4.53	0.74
Removal of all cola, ceiba (onyina) and oil palm trees.	173	3.86	0.79
Weeding of the cocoa farm before fertiliser application	194	3.83	0.81
Removal of basal chupons, overhead canopies, and mistletoes	194	3.80	0.81
Leaving of 8 trees per acre of the farm.	165	3.76	0.79
Removal of dead husks (pod and cherelles)	189	3.72	0.80
Weighted Mean ($\bar{X}$ w)	-	3.79	0.78

n=200. Source: Field Survey Data, 2006

Scale: 5=Very Effective (VE); 4=Effective (E); 3=Moderately Effective (ME); 2=Ineffective (IE); 1=Very Ineffective (VI)

Generally, farmers perceived each of the sub-components to be 'effective', with means ranging from 3.7 to 3.9. However, this excludes those few farmers whose farms were susceptible to water-logging and, therefore,

dug trenches on their farms to drain the excess water from their farms. They perceived it to be 'very effective' ($\bar{X}$ = 4.53, SD=0.74). Though farmers generally viewed the various sub-components to be effective, the relatively higher standard deviations ranging from 0.74 to 0.81 indicates that the farmers had varied views about the effectiveness of the sub-components of cultural maintenance.

Farmers perceived the cultural maintenance component as a 'whole' to be 'effective' ($\bar{X}$ w =3.7, SD=0.78) in contributing to increasing their yields. However, the standard deviation again showed that they were quite varied in their views so far as the effectiveness of the cultural maintenance was concern.

Perceived Effectiveness of the Fertiliser Application Component of the CHTP

The application of recommended fertiliser namely Asase Wura Special Fertiliser and Cocofeed is the main 'trust' of the CHTP. The fertilisers are distributed to beneficiary farmers on credit bases by government (CRIG) through the LBCs who registered the farmers. Application of the fertiliser follows immediately after cultural maintenance of the farm.

Table 9: Frequency Distribution of the of Respondents who Applied the Fertiliser Application Component of the CHTP

Application of Fertiliser	Yes		No	
	f	%	f	%
Application of the recommended fertiliser.	199	99.5	1	0.5
Ring method of application.	1	0.5	-	-
Broadcasting method of application.	198	99.0	-	-
Application of the fertiliser at the beginning of the rainy seasons.	83	41.7	116	58.3

n=200. Source: Field Survey Data, 2006

Table 9 shows that out of the 200 farmers sampled the majority (199) representing 99.5% applied the recommended fertiliser. However, almost all the farmers (99%) used the broadcasting method in applying the fertiliser. This may be due to relatively cheaper cost of labour in broadcasting method of application compared to that of the ring method. Though almost all the farmers applied the fertilizer, the majority of them (58.5%) could not apply the fertiliser at the beginning of the rainy seasons or when the rains were available as a result of late arrival of the fertiliser from the LBC's.

Out of the 199 farmers who applied the fertiliser, about 22% and 32% perceived it to be 'very effective' and 'effective' respectively while 43.2% thought that it was 'moderately effective' in increasing their yield (Table 10). The majority of the respondents (about 65%) who used the broadcasting method of fertiliser application perceived it to be at least 'effective'. Few respondents ranging from 0.5 to 14.5 percent perceived that the various sub-

components of the fertiliser application were either 'ineffective' or 'very ineffective' resulting in decrease in their yield.

Table 10: Frequency Distribution of Respondents' Perceived Effectiveness of Fertiliser Application Component of the CHTP

Application of Fertiliser	VE		E		ME		IE		VI		
	f	%	f	%	f	%	f	%	f	%	n
Application of the recommended fertiliser	45	22.6	64	32.2	86	43.2	1	0.5	3	1.5	199
Ring method of application.	1	100.0	-	-	-	-	-	-	-	-	1
Broadcasting method of application.	45	22.7	85	42.9	58	29.4	9	4.5	1	0.5	198
Application of the fertiliser at the beginning of the rainy seasons	29	34.9	19	22.9	23	27.7	12	14.5	-	-	83

n=200. Source: Field Survey Data, 2006 VE= Very Effective, E= Effective; ME=Moderately Effective; IE= Ineffective, VI= Very Ineffective

Table 11 shows the mean perceived effectiveness of the sub-components of fertiliser application. The means show that farmers perceived the various sub-components as well as the 'whole' fertiliser component of the programme to be 'effective' in increasing their cocoa yields. The standard

deviations, however, show that respondents were having varied views about the effectiveness of the fertiliser component of the programme.

It is also worthy to note that though only one respondent used the ring method of application, he perceived it to be very effective ($\bar{X}$ = 5) and, therefore, may be recommended to farmers if the cost of labour in using this method of application is relatively low.

Table 11: Mean Perceived Effectiveness of the Fertiliser Application Component of the CHTP

Application of Fertiliser	n	$\bar{X}$	SD
Application of the recommended fertiliser.	199	3.74	0.87
Ring method of application	1	5.00	-
Broadcasting method of application	198	3.83	0.85
Application of the fertiliser at the beginning of the rainy seasons	83	3.78	1.08
Weighted Mean ($\bar{X}$ w)		3.76	0.83

n=200. Source: Field Survey Data, 2006 Scale: 5=Very Effective (VE); 4=Effective (E); 3=Moderately Effective (ME); 2=Ineffective (IE); 1=Very Ineffective (VI)

Perceived Effectiveness of the Fungicide Application Component the CHTP

The fungicides used included Nordox and Rindomil. These are sprayed after fertiliser application and when trees start bearing flowers in order to control the black pod disease.

Table 12 shows the frequencies and proportions of respondents who sprayed the recommended fungicides on their farms. It revealed that the majority (88%) applied the fungicides supplied to them though 24 respondents (12%) did not. The majority (87%) also used the recommended application rate. However, about 28 (approximately 16%) out of the 176 farmers, who used the fungicides did not use knapsack sprayer which is the recommended sprayer. Some of them used motorised sprayer, instead of the knapsack since they did not have access to the knapsack. The pressure from the motorised sprayer destroys cocoa flowers and young cocoa pods and this may have affected their yields.

Table 12: Frequency Distribution of Respondents who Applied the Fungicide on their Cocoa Farms

Fungicide Application	Yes		No	
	f	%	f	%
Spraying of fungicides.	176	88.0	24	12.0
Application rate of 6 sachets of fungicides per acre	174	87.0	26	13.0
Use of Knapsack sprayer for spraying.	148	84.1	28	15.9

n=200. Source: Field Survey Data, 2006

Frequency distribution and means of farmers' perceived effectiveness of the fungicide sub-components are presented in Tables 13 and 14 respectively. A range of 91.4% to 94.5% of the farmers who applied each sub-component perceived it to be at least 'moderately effective' in controlling the black pod diseases (Table 13).

Table 13: Frequency Distribution of Respondents' Perceived Effectiveness of Fungicide Application Component of the CHTP

Fungicide Application	VE		E		ME		IE		
	f	%	f	%	f	%	f	%	n
Spraying of fungicides.	38	21.6	48	27.3	76	43.1	14	8.0	176
Application rate of 6 sachets of fungicides per acre.	33	19.0	48	27.6	78	44.8	15	8.6	174
Use of Knapsack sprayer for spraying.	21	14.2	35	23.6	84	56.8	8	5.4	148

n=200. Source: Field Survey Data, 2006 VE= Very Effective, E=Effective; ME=Moderately Effective; IE=Ineffective, VI=Very Ineffective

Table 14 also shows that the various sub-components as well as the fungicide component as a 'whole' were perceived to be 'effective' in controlling the black pod disease and consequently increasing their yields. The results confirm that of McGregor (1981), who found out that Ridomil and

Nordox, the recommended fungicides for controlling black pod under the CHTP, gave a substantial and significant reduction in numbers of infections arising from zoospores and significantly reduced percentage black pod on the field.

Again the standard deviations (ranging from 0.8 to 0.9) showed that farmers' views on the effectiveness of the fungicides were quite varied.

Table 14: Mean Perceived Effectiveness of the Fungicide Application component of the CHTP

Application of Fungicide	n	$\bar{X}$	SD
Spraying of fungicides	176	3.63	0.91
Application rate of 6 sachets of fungicides per acre	174	3.57	0.89
Use of Knapsack sprayer for spraying	148	3.47	0.80
Weighted Mean ($\bar{X}w$)	-	3.61	0.86

n=200. Source: Field Survey Data, 2006

Scale: 5=Very Effective (VE); 4=Effective (E); 3=Moderately Effective (ME); 2=Ineffective (IE); 1=Very Ineffective (VI)

Perceived Effectiveness of the Insecticide Application Component of the CHTP

Pods and cocoa trees are sprayed to treat the capsids insects. The most recommended insecticide is the Confidor, a systemic insecticide. The results from the study revealed that the majority (approximately 95%) of the respondents sprayed the insecticides at the recommended rate on their farms (Table 15). Few farmers (3.5%), who did not spray the supplied insecticides

on their cocoa farms, said that they either did not have a sprayer or used it to control pest on their vegetable farms since they saw it to be effective when they tried. Though few farmers misapplied the insecticides, it is noteworthy that the insecticide (confidor) is systemic and, therefore, the potential hazards this may cause to consumers of these vegetables should not be underestimated.

Pidwirny (2002), for example, reported that many human illnesses (e.g. cancer, mutations and congenital defects) and deaths have occurred as a result of pesticide contamination. He estimated that over the past 50 years there have been 20,000 deaths per year as a result of insecticide contamination including food contaminated with pesticides.

Table 15: Frequency Distribution of Respondents who Applied the Insecticide Component on their Cocoa Farms

Insecticides Application	Yes		No	
	f	%	f	%
Spraying of Insecticides	193	96.5	7	3.5
Spraying 2 tankfulls of mixture per acre (60 mls/acrea)	181	93.8	12	6.2
Use of a motorised mist blower	171	88.6	22	11.4

n=200. Source: Field Survey Data, 2006

Tables 16 and 17 present the frequencies and means respectively of farmers' perceived effectiveness of the insecticide component of the programme. Table 16 revealed that almost all the farmers' (about 99%) perceived the recommended insecticide as well as the rate of application and

the use of the motorised sprayer to be at least 'moderately effective' in controlling capsids.

Table 16: Frequency Distribution of Respondents' Perceived Effectiveness of Insecticide Component of the CHTP

Insecticides Application	VE		E		ME		IE		
	f	%	f	%	f	%	f	%	n
Spraying of Insecticides.	48	24.9	73	37.8	71	36.8	1	0.5	193
Spraying 2 tankfulls of mixture per acre(60 mls/acrea)	40	22.1	66	36.5	73	40.3	2	1.1	181
Use of a motorised mist blower.	31	18.1	70	40.9	69	40.4	1	0.6	171

n=200. Source: Field Survey Data, 2006 VE= Very Effective, E= Effective; ME=Moderately Effective; IE=Ineffective, VI= Very Ineffective

Table 17 also shows that the various sub-components as well as the fertiliser component as a 'whole' were perceived to be 'effective'. The standard deviations (ranging from 0.75 to 0.79) also indicate quite varied views. However; respondents' views about the insecticide component were more consistent than that of the three (3) preceding components of the CHTP discussed (cultural maintenance, fertiliser application and fungicide application components).

Table 17: Mean Perceived Effectiveness of the Insecticide Application Component of the CHTP

Application of Fungicide	n	$\bar{X}$	SD
Spraying of Insecticides.	193	3.87	0.79
Spraying 2 tankfulls of mixture per acre (60 mls/acrea)	181	3.80	0.79
Use of a motorised mist blower.	171	3.77	0.75
Weighted Mean ($\bar{X}$ w)		3.85	0.78

n=200. Source: Field Survey Data, 2006

Scale: 5=Very Effective (VE); 4=Effective (E); 3=Moderately Effective (ME); 2=Ineffective (IE); 1=Very Ineffective (VI).

Perceived Effectiveness of the Harvesting, Fermentation and Drying Component of the CHTP

Harvesting of the ripe cocoa pods at the right time, proper fermentation and drying practices enhance the quality of the cocoa beans. Heap fermentation of cocoa beans is widely used by farmers in Ghana and it is also the recommended method of fermentation by the CHTP.

Table 18 revealed that about 91% of the respondents harvested their cocoa pods at three (3) weeks intervals once the pods started ripening. The majority (87.7 %) of the farmers also fermented their cocoa beans for the recommended 6-7 days. This shows that the programme resulted in desirable changes in cocoa farmers' attitude toward the recommended period of fermentation because. Takrama (2006) asserted that though the recommended fermentation period is 6-7 days after opening and turning of the beans in heap

at 48 and 96 hours interval, most farmers still use 3-5 days fermentation period despite knowing of the appropriate recommendation. All the respondents dried their fermented beans in the sun and also at least nearly 85% perceived that it is an effective way of getting high quality beans (Table 19).

Table 18: Frequency Distribution Respondents who Applied the Harvesting, Fermentation and Drying Component of CHTP

Insecticides Application	Yes		No	
	f	%	f	%
Harvesting of pods every 3 - weeks once the pods begin to ripe	183	91.5	17	8.5
Fermentation for 6-7 days	175	87.5	25	12.5
Sun-drying of beans	200	100	-	-

n=200. Source: Field Survey Data, 2006

About 55% of the respondents generally perceived the 3-week time interval of harvesting ripe pods to be at least 'effective' since matured pods that are left on the trees for a long time may rot or shrink which may affect the size and quality of the beans and consequently their yields (Table 19). Again Table 19 shows that one-quarter (25.1%) of respondents, who used the recommended fermentation period perceived it to be 'very effective' whereas half of them considered it to be an 'effective' way of achieving high quality beans.

Table 19: Frequency Distribution Respondents' Perceived Effectiveness of Harvesting, Fermentation, Drying Component of CHTP

Harvesting, Fermentation and Drying	VE		E		ME		IE		
	f	%	f	%	f	%	f	%	n
Harvesting of pods every 3 - weeks once the pods begin to ripe.	40	21.9	82	44.7	55	30.1	6	3.3	183
Fermentation for 6-7 days.	44	25.1	88	50.3	39	22.3	4	2.3	175
Sun-drying of beans.	75	37.5	93	46.5	32	16.0	-	-	200

n=200. Source: Field Survey Data, 2006 VE= Very Effective, E= Effective; ME=Moderately Effective; IE=Ineffective, VI=Very Ineffective

Table 20 depicts the mean perceived effectiveness of the harvesting, fermentation and drying component of the CHTP and it shows that farmers perceived the aforesaid component to be effective (mean ranging from 3.85 to 4.42) and, therefore, added value to their cocoa beans.

Table 20: Mean Perceived Effectiveness of the Harvesting, Fermentation, and Drying Component of the CHTP

Harvesting, Fermentation and Dying	n	$\bar{X}$	SD
Harvesting of pods every 3 - weeks once the pods begin to ripe.	183	3.85	0.79
Fermentation for 6-7 days.	175	3.98	0.75
Sun-drying of beans.	200	4.22	0.69
Weighted Mean ($\bar{X}$ w)		4.04	0.66

n=200. Source: Field Survey Data, 2006

Scale: 5=Very Effective (VE); 4=Effective (E); 3=Moderately Effective (ME); 2=Ineffective (IE); 1=Very Ineffective (VI)

Table 21 shows the mean perceived effectiveness of the five (5) main components of the programme as well as the effectiveness of programme as a whole. The components in Table 21 are arranged in descending order of their means or effectiveness. These means reveal that farmers perceived each of the main components to be effective in contributing to yield and income either directly or indirectly.

Though all the main components were perceived to be effective, the harvesting, fermentation and drying component was perceived to be the most 'effective' and most practised component among the five (5) main components. This may be due to the fact that it requires less training as well as less technical know-how to adopt and apply as compared to the other components especially fertiliser, fungicide and insecticide application components of the programme.

Table 21: Mean perceived effectiveness of the main components of the CHTP

Main Components of the CHTP	n	$\bar{X}$	SD
Harvesting, fermentation & drying of cocoa beans	200	4.04	0.66
Application of insecticides	193	3.85	0.78
Cultural Maintenance	197	3.79	0.71
Application of fertiliser	199	3.76	0.83
Application of fungicide	181	3.61	0.86
Overall Mean Effectiveness (Weighted, $\bar{X}$ w)	-	3.81	0.66

n=200. Source: Field Survey Data, 2006

Scale: 5=Very Effective (VE); 4=Effective (E); 3=Moderately Effective (ME); 2=Ineffective (IE); 1=Very Ineffective (VI)

For example, during insecticide and fungicide application, farmers need to be trained in proper application rates, the time and conditions for application, safety procedures, and so forth. In addition, farmers need to also know how to operate, adjust, calibrate, and clean the sprayers and equipment used to achieve the best results. Swanson (1998) acknowledged that the transfer and implementation of such knowledge-based technology is more difficult than those that involve less technical knowledge.

The mean (weighted) shown in the Table 21 implies that farmers perceived the CHTP as a whole to be 'effective' ($\bar{X}$ w = 3.81, SD=0.66) and the standard deviation shows some level of consistency in respondents' views as far as the effectiveness of the CHTP as a 'whole'(composite) is concerned.

Perceived impact of the CHTP on Farmers' Livelihoods

Five categories of livelihood (capital) examined were natural, physical, financial, human and social.

Perceived Impact of CHTP on Natural Capital (Livelihood) of Farmers

Improvement in the natural capital or livelihood is the most immediate impact of any agricultural programme or project. Frequencies and percentages of respondents, who claimed that the CHTP improved the various aspects of their natural capital and those who did not are presented in Table 22.

The table shows that almost all the respondents (between 95% to 99.5%) reported that the CHTP increased their cocoa yields, increased their productivity (yield per unit cost and yield per unit area) and resulted in better quality of beans (increase in size and weight).

Table 22: Frequency Distribution of Respondents' Perceived Impact of CHTP on their Natural Capital

Perceived impact on Natural Capital.	Yes		No	
	f	%	f	%
Increase in yield.	190	95.0	10	5.0
Increase in yield per unit area.	193	96.5	7	3.5
Increase in yield per unit cost of inputs.	198	99.5	2	1.0
Better quality of beans.	189	94.5	11	5.5

n=200. Source: Field Survey Data, 2006

Table 23 depicts the frequency distribution of the level of perceived impact of the programme on various aspects of natural capital or livelihood of farmers who responded that there had seen improvements in the various facets of their natural capital. Approximately 43% of the respondents perceived that the increase in yield as a result of the programme was, at least, 'high' (VH=15.3% and H=27.4%) while 46.3 % claimed that it was 'moderately high' (increases in their yields were below their expectation). The rest (11 %) claimed that the impact on yield was either low or very low.

The Table 23 also indicates that more than one-quarter of the respondents perceived that increase in productivity in terms of both yield per unit area and yield per unit cost of input was 'high'. Nearly half of the respondents (47.2% and 48.0% respectively) perceived productivity in terms of yield per unit area and yield per unit cost of inputs of fertiliser and agrochemicals to be 'moderately high'. Few respondents (about 10%) claimed that their yield and productivity were 'low' while very few respondents (raging from 1 to 4 respondents) perceived that the CHTP had a 'very low' impact on the various aspects of their natural livelihood.

The majority (60%) of the farmers perceived that the impact of the programme on the quality of their cocoa beans was at least 'high' which implied that the programme resulted in the improvement of the quality of their cocoa beans in terms of size and weight. The findings seem to support Appiah's (2004b) work which reported that beans size and weight increased considerably on farms that were fertilised than unfertilised ones in the Ashanti Region.

Table 23: Frequency Distribution of Farmers' Level of Perceived Impact of CHTP on Natural Capital

Natural Capital (Livelihood)	VH		H		MH		L		VL		
	f	%	f	%	f	%	f	%	f	%	n
Increase in yield	29	15.3	52	27.4	88	46.3	20	10.5	1	0.5	190
Increase in yield per unit area.	27	14.0	51	26.4	91	47.2	21	10.9	3	1.6	193
Increase in yield per unit cost of inputs.	22	11.1	58	29.3	95	48.0	19	9.6	4	2.0	198
Better quality of beans	40	21. 2	73	38.6	69	36.5	6	3.2	1	0.5	189

n=200. Source: Field Survey Data. 2006

VH= Very High, H =High, MH=Moderately High, L= Low, VL= Very Low

Table 24 depicts the mean perceived impact of the programme on various aspects of farmers' natural livelihood. The various aspects of natural livelihood in Table 24 are arranged in descending order of means of responses. The results show that the impact of the programme on all the various aspect of respondents' natural livelihood (increase in yield, increase in yield per unit area, increase in yield per unit cost of inputs and better quality of beans) was 'high' with means ranging from 3.46 and 3.77. However, the standard deviations indicated that respondents were quite varied in their views.

The respondents also perceived that the impact on their natural livelihood as a 'whole' was 'high' ($\bar{X}$w =3.51, SD=0.83). Again, the respondents were varied in their views as indicted by the standard deviations.

Table 24: Mean Perceived Impact on Natural Capital

Natural Capital (Livelihood)	n	$\bar{X}$	SD
Increase in yield.	190	3.46	0.89
Increase in yield per unit area.	193	3.40	0.91
Increase in yield per unit cost of inputs.	198	3.38	0.88
Better quality of beans.	189	3.77	0.84
Weighted Mean ($\bar{X}$ w)		3.51	0.83

n=200. Source: Field Survey Data, 2006 Scale: 5= Very High (VH), 4 =High (H), 3=Moderately High (MH), 2 = Low (L), 1= Very Low (VL)

Perceived Impact of CHTP on Physical Capital (Livelihood) of Farmers

Farmers' physical capital includes sprayers, prunners, harvesters, and vehicles that helped them to cart their produce from either their farms to their homes or from their homes to the buying centres. Ownership or access to these equipment help farmers to carry on farm related activities such as spraying, pruning, harvesting and transportation.

The majority (about 70%) of the respondents claimed that they have not been able to acquire either sprayers (Knapsack or motorised) or prunners to be used to remove mistletoes and dead husk from their farms. Approximately 30% of the farmers claimed that they have been able to buy sprayers and prunners as a result of the CHTP (Table 25).

Table 25: Frequency Distribution of Perceived Impact of CHTP on Physical Capital of Cocoa Farmers

Perceived impact on Natural Capital	Yes		No	
	f	%	f	%
Ownership of Sprayers	54	27.0	146	73.0
Ownership of prunner	59	29.5	141	70.5
Ownership of Harvester	159	79.5	41	20.5
Access to vehicles	65	32.5	135	67.5
Access to Sprayers	172	86.0	28	14.0
Access to prunner	103	51.5	97	48.5
Access to Harvester	184	92.0	16	7.0

n= 200. Source: Field Survey Data, 2006

Table 25 also indicates that approximately 80% of the farmers interviewed said that they have been able to acquire their own harvesters as a result of the proceeds from the programme. More farmers have been able to acquire their own harvesters but not prunners or sprayers. This may be as a result of relatively cheaper cost of harvesters as compared to the cost of sprayers and prunners. Sixty-five (32.5%) out of the 200 farmers interviewed had access to vehicle to cart their yields from either farms to homes or their homes to the buying centres as a result of the programme.

The majority (86%) of the respondents had access to sprayers to spray their farms. Most of them said that they made use of the sprayers used by Cocoa Mass Spraying Programme. Half of the respondents claimed that they had access to prunners, but only 29.5% had their own prunners. The other 50%

who did not have access to prunners might find it difficult to remove mistletoes (major parasite of cocoa tree) that are found on top of the canopies of cocoa trees. This parasite may compete with the cocoa trees for the fertiliser and other nutrients.

Tables 26 and 27 show respectively, the frequency distribution and means of respondents' perceived level of impact on various aspects of physical capital as well as the physical capital as a 'whole'.

Table 26 shows that the majority of the respondents who said that the programme impacted on various aspects of their physical capital also perceived that the level of impact was 'high'. A wide range of the respondents (representing between approximately 9% and 30%) claimed that the level of impact was 'low' or 'very low'. This may have resulted because some farmers may not necessary use their income from their farms to buy such equipment or enhance their physical capital. Appiah (2004a) noted that farmers prefer expanding their existing farms size instead of improving the fertility of their cocoa farms. It therefore follows that income accumulated from their farms may have been used for other purposes rather than acquiring or enhancing their physical capital.

Table 26: Frequency Distribution of Farmers' Perceived Level of Impact of CHTP on Physical Capital

Level of perceived	VH		H		MH		L		VL		
impact on Physical Capital	f	%	f	%	f	%	f	%	f	%	n
Ownership of Sprayer.	18	33.3	6	11.1	19	35.2	10	18.5	1	1.9	54
Ownership of prunner.	19	32.2	4	6.8	17	28.8	17	28.8	2	3.4	59
Ownership of Harvester.	46	28.9	57	35.8	31	19.5	24	15.1	1	0.6	159
Access to vehicles.	18	27.7	18	27.7	19	29.2	9	13.8	1	1.5	65
Access to Sprayers.	25	14.5	32	18.6	87	50.6	27	15.7	1	0.6	172
Access to prunner.	24	23.3	20	19.4	43	41.7	15	14.6	1	1.0	103
Access to Harvester.	50	27.2	53	28.8	65	35.3	15	8.2	1	0.5	184

n=200. Source: Field Survey Data, 2006

VH= Very High, H =High, MH=Moderately High, L= Low, VL= Very Low

Means in Table 27 show that the farmers generally perceived that the level of impact of the programme on the various categories of their physical capital as well as the impact on the physical capital as a whole was 'high' with the exception of level of impact on ownership of prunners and access to sprayers where respondents perceived that they were 'moderately high' ($\bar{X}$ = 3.36 and 3.31 respectively). The standard deviations (mostly more than 1) again indicate that farmers differed in their views on impact on their physical capital. In fact, farmers were more in agreement their views regarding impact

on natural capital than physical capital (Compare the standard deviations in Tables 24 and 27).

Table 27: Mean Perceived Level of Impact on Physical Capital

Physical Capital	n	$\bar{X}$	SD
Ownership of Sprayer	54	3.56	1.19
Ownership of prunner	59	3.36	1.30
Ownership of Harvester	159	3.77	1.05
Access to vehicles	65	3.66	1.08
Access to Sprayers	172	3.31	0.93
Access to prunner	103	3.50	1.04
Access to Harvester	184	3.74	0.97
Weighted Mean ($\bar{X}$ w)		3.50	0.84

n=200. Source: Field Survey Data, 2006 Scale: 5= Very High (VH), 4 =High (H), 3=Moderately High (MH), 2 = Low (L), 1= Very Low (VL)

Perceived Impact of CHTP on Financial Capital (Livelihood) of Farmers

Farmers' financial capital includes their income, saving and debt levels as well as access to credit facilities either in cash or in kind. Results from the study, as shown in Table 28, reveal that the programme increased the levels of income of beneficiary farmers. Ninety-two percent (92%) of the 200 respondents sampled claimed that the CHTP increased their income levels. Fifty-nine percent (59%) of the farmers, however, claimed that they could not increase their savings. This is not surprising because the majority (177 out of the 184), who said that the programme helped to increase their incomes also

reported that they were able to decrease their debt levels. Since the programme offers all beneficiary farmers inputs (fertiliser, fungicides and insecticides) on credit basis and pay back after harvesting and selling their produce, it can be argued that they used the major part of their income to settle their debts. The 'left over', if any, after settling their debts may be used for other purposes rather than to save.

Table 28: Perceived Impact of CHTP on Financial Capital of Respondents

Perceived impact on Financial Capital	Yes		No	
	f	%	f	%
Increase in income levels	184	92.0	16	8.0
Increase in saving levels	82	41.0	118	59.0
Decrease in debt levels	177	88.5	23	11.5
Access to credit facility	38	19.0	162	81.0

n=200. Source: Field Survey Data, 2006

Strangely, only 19% of the 200 respondents were able to access credit after paying their loans. It was expected that farmers who were able to pay back their credits after selling will go for more packages of fertilisers and agrochemicals since they qualify automatically to receive more credit once they pay back their credits. It is possible that farmers did not actually pay back their credit in **full** to warrant them the next batch of credit from the government through the Licensed Buying Companies (LBCs). Another possible explanation could be that farmers may have diverted their produce to other LBCs, who did not register them since under the CHTP farmers pay

back credit they received from the government, through the LBCs who registered them, by using part of their produce. It, therefore, follows that farmers could easily avoid paying back the credit either in full or in part by diverting all or part of their produce to other LBCs instead of the one that registered them. If that was the case, then, consequently, they were disqualified to receive credit again from the LBC that had registered them resulting in few farmers being able to access credit for the second time.

Table 29 shows the frequencies and percentages of the levels of impact of the programme on respondents' financial capital. From the table, just over half (51.1 % out of the 184) of the respondents, who said that their incomes increased claimed that the increment was 'moderately high' or considerably high. Approximately 10% and 22% perceived that the increases in their income were 'very high' and 'high', respectively, than they expected while about 16% claimed that their increases in income were low. The mean perceived impact on income levels ($\bar{X}$ =3.22, SD=0.87) shown in Table 30 also depicts considerable ('moderately high') increase on income levels. The result is not far from the economic analysis of on-farm trials of fertiliser experiments in Ashanti region reported by Appiah (2004b), which showed that profitability levels were **higher** but **varied.** The minimum rate of returns on investment that farmers were prepared to accept was between 50-100%. It, therefore, follows that when farmers' income or profitability levels were below 50% they could perceive such income levels to be moderately high, low or very low and unacceptable.

Table 29: Frequency Distribution of Respondents' Perceived Level Impact of CHTP on Financial Capital

Level of perceived impact on Financial Capital	VH		H		MH		L		VL		
	f	%	f	%	f	%	f	%	f	%	n
Increase in income levels	17	9.2	41	22.3	94	51.1	30	16.3	2	1.1	184
Increase in saving levels	14	17.1	18	22.0	23	28.0	21	25.6	6	7.3	82
Decrease in debt levels	45	25.4	30	16.9	67	37.9	27	15.3	8	4.5	177
Access to credit facility	8	21.1	7	18.4	11	28.9	7	18.4	5	13.2	38

n=200. Source: Field Survey Data, 2006

VH= Very High, H =High, MH=Moderately High, L= Low, VL= Very Low

Table 29 again revealed that farmers (n=82), who were able to increase their saving levels had varied levels of savings ranging from 'very high' to 'very low'. Percentage of farmers in each of the aforesaid levels ranged from 17% to 28%. Mean perceived increases in saving levels, as in Table 30, showed 'moderately high' ($\bar{X}$ =3.16, SD=1.20) levels, which implied that saving levels were considerably high. However, the views of respondents on increases in saving levels were very inconsistent.

About 42% of the 177 respondents claimed that impact on debt levels were at least high (i.e VH= 25.4% and H=16.9%), while the rest (58%) claimed that impact was between 'moderately high' to 'very low' (Table 29).

This may imply that 42% were able to settle in full the credit received from the government that was why they claimed that decreases in their debt level were "high". Conversely, the other 58% out of the 177 respondents probably could not pay back the credit in full and, therefore, made part payments.

Table 30: Mean Perceived Level of Impact on Financial Capital of Farmers

Financial Capital	n	$\bar{X}$	SD
Increase in income levels	184	3.22	0.87
Increase in saving levels	82	3.16	1.20
Decrease in debt levels	177	3.44	1.16
Access to credit facility	38	3.16	1.33
Weighted Mean ($\bar{X}$ w)		3.27	0.88

n=200. Source: Field Survey Data, 2006

Scale: 5= Very High (VH), 4 =High (H), 3=Moderately High (MH), 2 = Low (L), 1= Very Low (VL)

Table 30 shows means and standard deviations of farmers' perceived impact on various categories of their financial capital as well as impact on their 'overall' financial capital. Impact on various categories of financial capital as well as impact on overall financial capital was perceived to be'moderately high'.

Perceived Impact of CHTP on Human Capital (Livelihood) of Farmers

Access to various forms of labour, both skilled and unskilled, and various sources of information, whether public or private, formed part of farmers' human capital or livelihood.

Table 31: Perceived Impact of CHTP on Human Capital of Farmers

Perceived impact on Human Capital	Yes		No	
	f	%	f	%
Access to skilled labour	161	80.5	39	19.5
Access to unskilled labour	184	92.0	16	8.0
Access to public extension services (AEAs)	136	68.0	64	32.0
Access to private extension services (e.g. NGOs, input dealers etc.)	4	2.0	196	98.0

n=200. Source: Field Survey Data, 2006

Frequency distribution of farmers' perceived impact of the programme on human capital is presented in Table 31. The results revealed that 80% and 92% of the 200 farmers interviewed had access to skilled and unskilled labour respectively. The skilled labourers, according to the farmers, were not directly as a result of the CHTP itself, but were the people, who were contracted to execute the cocoa mass spraying programme. Since these workers were trained by MoFA, they helped farmers to measure agrochemicals, calibrate sprayers, spray and direct them in other safety precaution measures.

Unskilled labour used for weeding, fertiliser application, harvesting and other post-harvest activities were mainly from family labour and hired labour. Appiah (2004b) also found in his pilot study that introduction of cocoa technologies especially fertiliser application and mass spraying resulted in creating employment for the youths in cocoa farming communities. This, he concluded, was as a result of the fact that whereas on the average, almost all pods were harvested at three (3) harvest times from unfertilised farms, the frequency of harvesting on fertilised farms was about nine (9) harvests per year. The increased frequency of harvest as well as the improved cultural and agronomic practices created job opportunities for the rural youth thereby reducing the frequency of the migration of rural youth to the urban areas.

Family labour was also an important source of labour Average household size of farmers sampled (Table 48) was nine (9). This may have been a substantial source of labour for the farmers. Family labour was found to be the most used labour type in a survey conducted by IITA (2002) in four (4) West African countries including Ghana. For example, 87 percent of the permanent labour used in cocoa farming was from the family (IITA, 2002).

The results from the study also indicated that while the majority (68%) of the farmers said that the programme increased the frequency of contact with public extension officers (AEAs), substantial percentage (32%) of them claimed that it did not (Table 31). Very few farmers (4 out of 200) had access to private extension officers such as staff of NGOs, retired AEAs and input dealers.

Table 32: Frequency Distribution of Respondents' Perceived Level of Impact of CHTP on Human Capital

Level of perceived impact on Human Capital	VH		H		MH		L		VL		
	f	%	f	%	f	%	f	%	f	%	n
Access to skilled labour	17	10.6	26	16.1	70	43.5	45	28.0	3	1.9	161
Access to unskilled labour	22	12.0	40	21.7	81	44.0	39	21.2	2	1.1	184
Access to public extension services (e.g. AEAs)	25	18.4	31	22.8	60	44.1	19	14.0	1	0.7	136
Access to private extension services (e.g. NGOs, input dealers)	-	-	1	25.0	1	25.0	2	50.0	-	-	4

n= 200. Source: Field Survey Data, 2006

VH= Very High, H =High, MH=Moderately High, L= Low, VL= Very Low

The frequency distribution and means of farmers perceived level of impact of the programme on various aspects of their human capital are presented in Tables 32 and 33 respectively. The two tables show that nearly half of the respondents (43.5%, 44.0% and 44.1% respectively) claimed the level of impact on access to unskilled labour, skilled labour and access to public extension services was 'moderately high'. Mean perceived level of impact on various aspects of farmers' human capital as well as "overall" capital was also 'moderately high' as shown in Table 33.

Table 33: Mean Perceived Impact on Farmers Human Capital

Human Capital	n	$\bar{X}$	SD
Access to skilled labour	161	3.06	0.97
Access to unskilled labour	184	3.22	0.95
Access to public extension services (e.g. AEAs)	136	3.44	0.97
Access to private extension services (e.g. NGOs)	4	3.25	0.96
Weighted Mean ($\bar{X}$ w)	-	3.27	0.88

n= 200. Source: Field Survey Data, 2006 Scale: 5 Very High (VH), 4 High (H), 3 Moderately High (MH), 2 Low (L), 1 Very Low (VL)

Perceived Impact of CHTP on Social Capital (Livelihood) of Farmers

Farmers' ability to feed their family members, pay school fees of their wards, support other people and join and benefit from associations and farmer groups are considered as some of the indicators of improvement on their social capital.

Results from the study, shown in Table 34, indicate that few farmers (only 14%) were able to join and benefited from farmer groups or associations as a result of the programme. The result is contrary to Appiah's (2004b) survey done in the Ashanti Region where all farmers who adopted the CHTP joined farmer associations. It is also worthy to note that though few farmers joined associations or farmer groups, all who joined benefited from it in a way: either through access information or other social benefits. It is possible there were no initiation of such farmer groups in most of the farming communities and even

if they were, most were not interested probably because of failure of existing farmer groups to make impact on their lives.

Table 34: Perceived Impact of CHTP on Social Capital of Respondents

Perceived impact on Social Capital	Yes		No	
	f	%	f	%
Membership/association to farmer group	29	14.5	171	85.5
Support /association to farmer group	29	14.5	171	85.5
Ability to feed family members	194	97.0	6	3.0
Support to other family members	142	71.0	58	29.0
Support to friends	101	50.5	99	49.5
Ability to pay school fees.	185	92.5	15	7.5
Other Social Obligations(e.g. funeral dues and basic rate)	188	94.0	12	6.0

n=200. Source: Field Survey Data, 2006

The majority of the respondents were able to feed their family (97%), support other family members (71%), pay their wards school fees (92.5%), and perform other social obligations (94%) such as paying of basic rate, and funeral dues.

Frequencies and percentages of farmers' level of perceived impact on social capital are presented in Table 35. About 45 % out 29, who reported that they benefited from being members of farmer groups or associations said that the level of impact was at least 'high' (VH=10.3%, H=34.5%). The majority (66%) of the 194 respondents, who were able to feed their family, said that the

level of impact was 'moderately high' that is the contribution of the programme to their being able to feed their family members in their households was quite better than when they had not adopted the programme.

Table 35: Frequency Distribution of Respondents' Perceived Level of Impact of CHTP on Social Capital

Level of perceived impact on Social Capital	VH		H		MH		L		VL		
	f	%	f	%	f	%	f	%	f	%	n
Membership to association/farmer group.	3	10.3	11	37.9	12	41.4	1	3.4	2	6.9	29
Support from association/farmer group.	3	10.3	10	34.5	11	37.9	3	10.3	2	6.9	29
Ability to feed family members.	17	8.8	31	16.0	128	66.0	16	8.2	2	1.0	194
Support to other family members	7	4.9	15	10.6	65	45.8	48	33.8	7	4.9	142
Support to friends.	7	6.9	4	4.0	46	45.5	35	34.7	9	8.9	101
Ability to pay school fees.	19	10.3	31	16.8	106	57.3	28	15.1	1	0.5	185
Other Social Obligations(e.g funeral dues and basic rate)	5	2.7	24	12.8	134	71.3	23	12.2	2	1.1	188

n=200. Source: Field Survey Data, 2006

VH= Very High, H =High, MH=Moderately High, L= Low, VL= Very Low

The majority of the respondents (ranging from 45.8% to 71.3%) perceived that the level of impact on the rest of the aspects of social capital examined (Table 35) was 'moderately high'. A substantial number of farmers, approximately 35%, rated both their ability to support other family members, and friends to be 'low'. If this is compared to the percentage of farmers who rated their ability to feed their family and pay their wards' school fees as 'low' (15.1% and 8.2% respectively), it is realized that farmers' support to their family and household takes precedence over that of other family members and friends.

Table 36: Mean Perceived Level of Impact on Social Capital of Respondents

Social Capital	n	$\bar{X}$	SD
Membership to association or farmer group	29	3.41	0.98
Support from association/farmer group	29	3.31	1.04
Ability to feed family members	194	3.23	0.76
Support to other family members	142	2.77	0.89
Support to friends	101	2.65	0.95
Ability to pay school fees.	185	3.21	0.84
Other Social Obligations (e.g. funeral dues and basic rate)	188	3.04	0.63
Weighted Mean ($\bar{X}$ w)		3.02	0.62

n=200. Source: Field Survey Data, 2006 Scale: 5= Very High (VH), 4 =High (H), 3=Moderately High (MH), 2 = Low (L), 1= Very Low (VL)

Table 36 shows the means and standard deviations of respondents' perceived level of impact of the programme on various aspects of their social capital. The results show that farmers generally perceived that the impact on various categories of social capital was 'moderately high' with means ranging from 2.65 to 3.41. Though few farmers joined and benefited in farmer associations, the impact on them was relatively higher ($\bar{X}$ =3.41, SD= 0.89 and 3.31, SD=1.04) than other aspects of social capital examined. However their views were varied as shown by their standard deviations.

Impact on farmers' social capital as a 'whole' was perceived to be 'moderately high' ($\bar{X}$ w =3.02, SD= 0.62). The programme, therefore, helped them improve considerably their social lives and activities.

Impact on Various Facets of Farmers' Capitals (Livelihoods)

Table 37 shows the means and standard deviations of impact on the five (5) main facets of farmers' livelihood examined in the study. The various categories of livelihood in Table 37 have been arranged in descending order of means of responses.

The results from the Table 37 show that impact on both natural and physical capitals of farmers was 'high' with means of 3.51 and 3.50 respectively while impact on human, financial and social capital was perceived to be 'moderately high'. Standard deviations of various categories generally revealed high inconsistency in farmers' views with the exception of social capital where farmers' views were quite consistent (SD=0.62).

Table 37: Mean Perceived Impact on Various Categories of Farmers' Capitals (Livelihoods)

Livelihoods Category	n	$\bar{X}$	SD
Natural Capital	199	3.51	0.83
Physical Capital	196	3.50	0.84
Human Capital	197	3.27	0.88
Financial Capital	190	3.27	0.88
Social Capital	198	3.02	0.62
Mean (Weighted, $\bar{X}$ w) Impact on livelihoods		3.32	0.62

n=200. Source: Field Survey Data, 2006 Scale: 5= Very High (VH), 4 =High (H), 3=Moderately High (MH), 2 = Low (L), 1= Very Low (VL)

High impact on both natural (e.g. yield and productivity) and physical (equipment such as sprayer, prunners, harvesters) capitals seems to imply that farmers are likely to use profit from their farms to buy inputs that would help them maintain their farms than to use it in advancing other aspects of livelihoods (human and social).

Improvements in 'immediate' capitals (i.e. physical and natural capitals) which involve increases in yield does not automatically translate into improvement in other aspects of farmers capital such as human, financial and social capital which include income and savings as well as other social activities. But as farmers' natural and physical capital increase substantially, they may improve other aspects of their lives provided they are able to satisfy their immediate obligations first. To ascertain the actual impact of agricultural technologies, Omoto (2004) recommended the assessment of impact at two

main levels (the direct product of technology and the people level impact.), and these are captured in the Sustainable Rural Livelihood Framework (SRL) used for this study.

Farmers' perceived the level of impact of the programme on their livelihoods as a whole to be 'moderately high' ($\bar{X}$ w =3.32, SD= 0.62). This implies that the impact of the programme on farmers' livelihoods was generally 'high' or satisfactory but not as high as they anticipated in terms of the yield, income and other aspects of livelihoods measured.

Perceived Level of Impact of the CHTP on Livelihoods of Farmers in the Four (4) Districts of the Study area

Results of the perceived impact of the CHTP on livelihoods of farmers in the individual districts show different levels of impact among the districts (Table 38). The level of impact of the programme on farmers' livelihoods was highest in Fanteakwah District followed by Birim North, Birim South, and East Akim districts respectively. Farmers in both Fanteakwah ($\bar{X}$ 3.99, SD=0.63) and Birim North ($\bar{X}$ =3.60, SD=0.44) districts perceived impact levels to be 'high' while the other two districts (Birim South, and East Akim) was 'moderately high' (Table 38). Responses of farmers in all the districts did not differ widely as shown by their relatively low standard deviations in each district.

Table 38: One-Way Analysis of Variance (ANOVA) of Mean Perceived Impact of CHTP on Respondents' Livelihoods in the 4 Districts of the Study Area

District	n	$\bar{X}$	SD	F ratio	Sig.
Fanteakwah	38	3.99	0.63	57.593	0.000*
Birim North	41	3.60	0.44		
Birim South	68	3.20	0.29		
East Akim	53	2.81	0.48		
Weighted Mean ($\bar{X}$ w)		3.31	0.62		

n=200. Source: Field Survey Data, 2006 *p < 0.05 Scale: 5= Very High (VH), 4=High (H), 3=Moderately High (MH), 2 =Low (L), 1= Very Low (VL)

One way analysis of variance (ANOVA) was computed to determine whether statistically significant differences existed among the mean levels of perceived impact of the programme on farmers' livelihood in the four (4) districts of study. The results, as shown in Table 38, revealed that statistically significant (sig. 0.000) differences existed among the mean perceived impact of the programme in the four (4) districts at 0.05 alpha level. This implied that the differences in level of impact of the programme in the four districts were not due to chance. Therefore, the first null hypothesis of the study that stated that there were no significant differences in the level of perceived impact of the CHTP on farmers' livelihoods among the four districts was rejected. The alternative hypothesis was, therefore, accepted.

Table 39 shows Levene's test of homogeneity of variances among the mean perceived impact of the programme in the four districts. Levene's test

was used to determine the appropriate post hoc multiple comparison to be used to determine where significant differences actually existed among mean impact of the four districts since the F-test showed significant differences. The Table 39 reveals that variances that existed among the means were highly significant. This implied that **equal variances are not assumed** among the four (4) districts. Based on the outcome of the Levene's test, Tamhane's T2 was chosen as the appropriate post hoc multiple comparison technique for the multiple comparisons of mean differences among the district.

Table 39: Levene's Test of Homogeneity of Variances in the 4 Districts

Levene Statistics	Sig.
7.115	0.000*

$p < 0.05$. * Equal Variance not Assumed

Table 40: Tamhane's T2 Post Hoc Multiple Comparison of Mean Perceived Impact of CHTP on Livelihood in the 4 Districts

Districts		Mean Difference		
A	B	(A – B)	Std. Error	Sig.
Birim South	East Akim	0.353*	0.083	0.000
	Fanteakwah	- 0.829*	0.092	0.000
	Birim North	- 0.437*	0.090	0.000
East Akim	Fanteakwah	-1.182*	0.097	0.000
	Birim North	- 0.792*	0.095	0.000
Fanteakwah	Birim North	- 0.390*	0.102	0.014

n=200. * **p< 0.05** Source: Field Survey Data, 2006

The Table 40 shows a multiple comparison of mean perceived impact among the four districts. The table revealed that mean differences among them: Fanteakwah ($\bar{X}$ 3.99, SD=0.63), East Akim ($\bar{X}$ 2.81, SD=0.48) Birim North ($\bar{X}$ 3.60, SD=0.44), and Birim South ($\bar{X}$ 3.20, SD=0.29); were statistically significant with one another at 0.05 alpha level. It implies that differences actually existed among the districts in terms of the impact of the CHTP on their livelihoods.

Such differences in impact may be as the result of how well farmers applied each of the components of the programme in each district. Example, the number of times they weeded their farms. Other external factors may have also resulted in such differences, which were beyond the control of the programme or farmers. One of such factors could have been the availability and distribution of rainfall in the various districts during application of fertiliser and also flowering of cocoa trees.

Strengths, Problems and Solutions to Problems of the CHTP: The Farmers' Perspective

Major Strengths of the CHTP as Perceived by Farmers

The Table 41 shows the major strengths of the programme as perceived by the beneficiary farmers. Perceived strengths of the programme depicted in Table 41 are arranged in descending order of the number of responses. It can be deduced from the table that most of the farmers (80%) perceived the fertiliser application component to be the main strength of the programme followed by insecticides application (Confidor), cultural maintenance and fungicides application. Most farmers were particularly

appreciative of the fertiliser and the insecticides components of the programme.

Table 41: Farmers Perceived Strength of CHTP

Major Strengths of CHTP	f	%
Effectiveness of fertiliser	160	80.0
Effectiveness of Insecticides (Confidor)	143	71.5
Cultural Maintenance	33	16.5
Effectiveness of Fungicides	29	14.5

Source: Field Survey Data, 2006 n = 200 (Multiple Responses)

Major problems encountered and solutions to the problems of the CHTP as perceived by cocoa farmers

Major problems encountered by cocoa farmers in applying CHTP are presented in Table 42. Solutions to the problems suggested by farmers are also presented in Table 43. The problems in Table 42 are listed in a decreasing order of responses by farmers and, consequently, decreasing order of importance of the problem as perceived by the farmers.

The main problem encountered by farmers was that they received the inputs, especially the fertiliser, later than they expected. After cultural maintenance of the farm, the next step that follows is the application of the fertiliser, if the rains fall. Due to the late arrival of fertiliser, most farmers were unable to apply the fertiliser during the beginning of the raining seasons or when the rains fell (Compare with Table 9). As reported earlier, in Table 9, 116 out of 199 farmers representing 58.3% could not apply the fertiliser at the

appropriate time when the rains fell due to late arrival of the inputs. This could affect the effectiveness of the fertiliser in increasing yield. Farmers, therefore suggested, as shown in Table 43, that the inputs, especially the fertiliser, should be made available in appropriate time before the start of rains.

Table 42: Farmers Perceived Problems of CHTP

Major Problems/Weaknesses of CHTP	f	%
Late arrival of inputs (especially fertiliser)	99	49.5
High cost of weeding due to quicker growth of weeds.	89	44.5
Inadequate training, supervision and monitoring of farmers by AEAs.	41	20.5
Unavailability of Spraying machine	37	18.5
High cost of input of CHTP	24	12.0
Inadequate inputs	13	6.5
Difficulties in transportation of inputs	10	5.0
Difficulty in getting labour for weeding	10	5.0

Source: Field Survey Data, 2006 n = 200 (Multiple Responses)

Another problem farmers encountered was high cost of weeding due to the quicker growth of weeds in the farms. Since weeds also make use of the fertiliser it resulted in quicker growth of weeds and this was anticipated by the programme. Appiah (2004a) reported that improved cultural practices, such as weeding, created job opportunities for the rural youth thereby reducing the frequency of the migration of rural youth to the urban areas. The implication is that though this created job for the rural youth, it also increased the cost of

labour to the farmers. Farmers, therefore, suggested that weedicide should be included as one of the components of the CHTP (Table 43). This would help to reduce, to some extent, the cost of labour for weeding. Few farmers (37) also suggested that if the weedicide could not be included as one of the components of the programme, government should provide soft loans to beneficiary farmers so that they could use it for offsetting the cost incurred in weeding and other cultural maintenance practices on their farms.

Some farmers also claimed that the training they received from the AEAs, as well as the supervision and monitoring of the programme, was not adequate. As part of the programme, selected AEAs in the districts were mandated to train beneficiary farmers to measure their farms, calibrate their spraying instruments, mix the agrochemicals using appropriate application rate and other cultural maintenance of the farmers' farms. They were also required to monitor the progress of the farms of beneficiary farmers. If some farmers claimed that they did not receive this attention, it may also have affected the accurate implementation of the various facets of the programme and consequently the outcome. They, therefore, suggested that more AEAs should be brought to their respective communities.

It should not be surprising for the inability of the AEAs to accomplish such tasks because of the relative shortage of AEAs in the country coupled with the other numerous tasks they have to perform within their operational areas.

Table 43: Solution to Problems of CHTP

Solutions to Problems of CHTP	f	%
Timely Supply of fertiliser and other inputs.	70	35.0
Supply of weedicides as part of the CHTP package.	60	30.0
Provision of soft loans by the government for cultural maintenance of farms.	37	18.5
Provision of Spraying Machine (mist blower/knapsack).	32	16.0
Reduction in the cost of inputs by the Government.	32	16.0
Regular visits and supervision by AEAs.	25	12.5
Early arrival of spraying machines from the Mass Spraying programme.	25	12.5
Deduct cost of credit from source that credit would be 'free'.	25	12.5
Supply of prunners.	14	7
Adequate training of cocoa farmers by AEAs on CHTP technologies.	10	5

Source: Field Survey Data, 2006 n= 200 (multiple responses)

Some farmers also reported that they did not have access to spraying machines (Knapsack and mist blower) for the application of the fungicides and insecticides. This resulted in 24 out of 200 farmers, who though received the fungicides, did not apply it at all on their farms (Table 12). Even some of the farmers, who applied the fungicides, did not use the appropriate sprayer to spray in order to increase the efficiency of the fungicides. For example, 28 out

of the 176 farmers who applied the fungicides did not use the recommended sprayer (knapsack). They argued that since they did not have access to the knapsack sprayer, they used the mist blower, which was available. The use of the mist blower may affect or drop some flowers and young cocoa pods since the fungicides are applied at flowering and the earlier stage of fruiting. Farmers, therefore, suggested that they should be provided with sprayers in the community so that they could schedule the use of such sprayers. Some also suggested that since they sometimes use the sprayers that are also used by the mass spraying programme, they should be given the sprayers earlier before they start the mass spraying exercise.

Some (16%) farmers also lamented that the cost of the CHTP was high and therefore should be reduced. Others also reported that the inputs were not adequate for them and suggested that the quantity of inputs should be increased to cover larger land size (more than 2 acres) since inputs are supplied for 2 acres under the CHTP. The farmers who recommended an increase in the quantity of inputs may have been those, who were able to pay back their credit supplied to them under the programme. Some farmers also reported that the cost of transportation of the fertilisers to their farms was high. Few also claimed that labour was not readily available for the weeding and other cultural maintenance practices.

Differences in Male and Female Perceived Effectiveness of the CHTP

The male to female ratio of respondents in the study was 3:1 (Table 44). The result from the study is not too far from that of a survey conducted by Cocoa Research Institute of Ghana (CRIG) in the Ashanti Region (1995),

which revealed that there were 71% male and 29% female cocoa farmers in the region.

Table 44: Independent Sample t-test between Male and Female Farmers Perceived Effectiveness of the CHTP

Sex	n	$\bar{X}$	SD	Mean Difference	t-ratio	Sig.
Male	150	3.79	0.633	0.052	0.479	0.63
Female	50	3.85	0.739			

p< 0.05 n =200 Source: Field Survey Data, 2006

Scale: 5=Very Effective (VE); 4=Effective (E): 3=Moderately Effective (ME); 2=Ineffective (IE); 1=Very Ineffective (VI)

Table 44 presents means and standard deviations of the perceived impact of the programme on both male and female cocoa farmers in the four districts as well as an independent t-test between male and female farmers' perceived effectiveness of the programme. The means shows that both male ($\bar{X}$ =3.79, SD=0.63) and female ($\bar{X}$ =3.85, SD=0.74) farmers in the study area perceived the programme to be 'effective'. However, the females perceived the programme to be a little bit more 'effective' than males.

The independent t-test (Table 44), however, shows that there was no significant (sig. 0.63) difference between the male and female perceptions on the effectiveness of the CHTP at 0.05 alpha levels. This means that the programme was effective for both male and female farmers. We, therefore, fail to reject the second (2) null hypothesis which stated that "there is no

significant difference between male and female farmers' perceived effectiveness of the CHTP".

Nelson (1981) had argued that programmes that are effective for males do not automatically translate into an effective programme for women, as well. The results from the study revealed that the programme 'worked' for or was effective for both male and female cocoa farmers. This could have been the result of the package of the CHTP, which was gender sensitive or not biased. For example, beneficiary cocoa farmers received the same amount of credit irrespective of the sex of the farmer and the size of farmer's farm.

Gamble and Gamble (2002) also asserted that men and women perceive different realities, have different expectations set for them, and that while women are categories as emotional, men are classified as rational. The results of the study again proved otherwise. If those assertions of Gamble and Gamble (2002) were true, then both male and female perceptions about the effectiveness of CHTP would be considered as either rational or emotional. Also, the programme might have met expectations of both male and female farmers in the same direction.

Demographic and Farm Related Characteristics of Cocoa Farmers

Age of Cocoa Farmers

Table 45 shows the frequency distribution of the age of respondent in the study area. The table shows that majority (approximately 64%) of the 178 respondents were 50 years or older. The mean age of cocoa farmers was 56 years and the oldest farmer was about 109 years. Very few farmers (21 out of 178 respondents representing 11.7%) were below 40 years. The results

generally show that cocoa farmers in the region were old and aging. Health of individuals normally declines with old age and this can affect the work a farmer can do in his/her farm and consequently his/her production.

These results are consistent with other studies that revealed that the average age of farmers in the farming communities in Ghana lies between 50 and 60 years and majority of farmers are over 50 years (La-Anyane, 1985; Dankwa, 2002). The average age of farmers (56 years) in the study area was however, 10 years more than that of cocoa farmers in Ashanti and Western region where a study revealed an average age of 46 years (Edwin and Masters, 2003).

Table 45: Frequency Distribution of Age of Farmers

Age Range (Years)	Frequency	Percentage	Cum. %
20 – 29	2	1.1	1.1
30 - 39	19	10.6	11.7
40 – 49	44	24.7	36.4
50 – 59	39	21.9	58.3
60 – 69	37	20.8	79.1
70 - 79	30	16.9	96.0
80 – 89	4	2.2	98.2
90 and Above	3	1.8	100.0
Total	178	100	-

n=200. Source: Field Survey Data, 2006

$\bar{X}$ =56.3, SD=14.2 Bimodal=48,60 Min=24, Max = 109

Educational Background of Cocoa Farmers

Table 46 shows the educational background of respondents. It revealed that just over half (54.6%) of the farmers had Middle School education. The results also revealed that about 80% of the respondents had formal education. Few farmers (about 20%) had no formal education and very few (3.1%) had tertiary education.

Table 46: Educational Background of Cocoa Farmers

Highest Educational Qualification	Frequency	Percentage
No Formal Education	39	19.9
Primary Education	26	13.3
Middle School Leaving Certificate	107	54.6
Basic Education Certificate	2	1.0
General Certificate Examination	13	6.6
Senior Secondary School Certificate	3	1.5
Tertiary	6	3.1
Total	196	100.0

n=200. Source: Field Survey Data, 2006

Byrness and Byrness (1978) have opined that education enhances one's ability to receive, decode, and understand information and that farmer's level of education, to some extent, determines the type of tasks he/she can undertake in any programme, and therefore the type and level of participation. Since majority (approximately 80%) had had some form of formal education, it was possible they were able to understand the components of the programme

to some extend. However, since their level of education was generally low, it is probable that it affected their ability to perform some critical tasks (e.g. calibration of sprayers, measurement and mixing of agrochemicals) that required a little bit of higher education.

The results of the study also are at variance with findings of other studies. For example, Aryeetey (2004) reported that in the rural areas where majority are farmers, only 29.3% of the people sampled had formal education. Dankwa (2002) and Kumi (2003) also reported that 50-55% of cocoa farmers have been found to have no formal educations.

Cocoa Farmers' Years of Experience

Considerable amount of experience may facilitate adoption of cocoa technologies. The results from the study shown in Table 47 revealed that about 94% of the farmers had 10 or more years of farming experience in cocoa production. Approximately 62% had been cocoa farmers for 20 to 49 years.

Table 47: Years of Experience as a Cocoa Farmer

Years of Experience	Frequency	Percentage	Cum. %
Less than 10	12	6.2	6.2
10 - 19	54	27.7	33.9
20 - 29	64	32.8	66.7
30 – 39	37	19.0	85.7
40 – 49	19	9.7	95.4
50 or more.	9	4.6	100
Total	195	100	-

Source: Field Survey Data, 2006. $\bar{X}$ =24.2, SD=13.0,Mode=20,Min=3, Max70

The mean year of experience of farmers in the study area was 24 and it is almost the same as the study done by Dankwa (2002) in Ashanti region. He found the average years of experience of cocoa farmers to be 23. He also found that 80.7% of those farmers had worked between 10 and 40 years.

Household Size of Cocoa Farmers

About 70% of the respondents had 5-10 members in their household. Few farmers (11 out of 189 respondents representing 5.8%) had household size below five (5). Only about 3 percent of the farmers had household size of more than 15 (Table 48). The mean household size was approximately nine (9).

The average household size of nine (9) was a little bit higher than the results from Aryeetey (2004), who reported that average household size in rural forest in Ghana was 6.9. Asante-Mensah (1988) found that about 18% of farmers had more than 15 members in their household. The results from the study show that few farmers (3%) had larger household size (more than 15 members) as compared to the report of Asante-Mensah (1988) showing that household sizes have reduced considerable over the years.

The average size of household of 9 and majority (70%) of farmers having a relatively larger family size (5-10) could imply that cocoa farmers in the study area may have readily available labour since family labour has been found to be the most prevalent labour type in cocoa farming in West Africa (IITA, 2002). About 87 percent of the permanent labour used in cocoa farming comes from the family (IITA, 2002).

Table 48: Size of Household of Cocoa Farmer

Household Size	Frequency	Percentage	Cum. %
Less than 5	11	5.8	5.8
5 - 10	132	69.8	75.6
11 – 15	40	21.2	96.8
16 or more	6	3.2	100
Total	189	100.0	-

n=200. Source: Field Survey Data, 2006

$\bar{X}$ =8.8, SD=3.7, Mode=8, Min=1, Max = 26

Number of Cocoa Farms Owned by Farmers

The Table 49 presents the number of cocoa farms own by farmers in the study area. The majority of the farmers interviewed owned one (35.9%) or two (40.9%) cocoa farms. About 90% of the respondents own between 1 to 3 cocoa farms. This finding corroborate that of Edwin and Masters (2003), who reported that all (100%) of the 123 farmers that they sampled for their survey in Ashanti and Western regions had between 1 to 3 cocoa farms.

Most agricultural lands are owned by families and clans and are normally distributed among family members, which may result in fragmentation of lands. Such land sizes may be small for large scale farming. Farmers may, therefore, own lands at more than one location if they have to expand their farms by renting additional land at different location.

Table 49: Number of Cocoa Farms owned by Farmers

Number of cocoa farms	Frequency	Percentage	Cum. %
One	71	35.9	35.9
Two	81	40.9	76.8
Three	26	13.1	89.9
Four	14	7.1	97.0
Five	4	2.0	99.0
Six	2	1.0	100.0
Total	198	100.0	-

n=200. Source: Field Survey Data, 2006 $\bar{X}$ =2.0 SD=1.1

Age of Cocoa Trees when the CHTP was Applied

Cocoa trees in the area are generally aging. About 70% of the respondents have cocoa farms with trees of up to 29 years old while the rest (30%) have farms that are at least 30 years of age.

Table 50: Age of Cocoa Trees where CHTP was Applied

Age of trees (Years)	Frequency	Percentage	Cum. %
Less than 10	7	3.7	3.7
10 - 19	58	30.9	34.6
20 – 29	67	35.6	70.2
30 – 39	36	19.2	89.4
40 or more	20	10.6	100.0
Total	188	100.0	-

n=200. Source: Field Survey Data, 2006
$\bar{X}$ =23.4, SD=10.1, Mode=20, Min=4, Max = 60

The mean age of cocoa trees in the study area was approximately 24 years. The range of the age of cocoa trees in the study area was 56 years (i.e.4 years minimum and 60 years maximum) as reported in Table 50.

Yields of cocoa have been found to decrease when cocoa trees age. Edwin and Masters (2003) reported that yields of cocoa farms are highest when trees are between 8 and 15 years old for both hybrids and traditional varieties and after that declines with age even when fertiliser is applied. They also reported an average age of cocoa trees of 20 years (in 192 cocoa farms surveyed in Ashanti and Western regions) with a minimum and a maximum 3 and 56 years respectively. Results from this study are comparable to that of Edwin and Masters (2003). The implication is that since a significant number of farmers (30%) in the study area had aged cocoa farms, it may have affected their yield even though they applied fertiliser.

Size of Cocoa Farms

Table 51 shows the total land size of respondents. The results from the table indicate that about 66% out of the 199 cocoa farmers interviewed had 10 or less acres of total farm size under cocoa cultivation. Few farmers (11%) had more than 20 acres of land under cocoa cultivation. The average size of land under cocoa cultivation in the study area was 10.5 acres (4.2 ha).

Edwin and Masters (2003) again found from their survey in Ashanti and Western regions that the average farm size of cocoa farmers was 3.50 ha (8.8 acres). The average farm size in the study area was 2 acres higher than that of the survey done in Ashanti and Western Regions.

Table 51: Total Land Size of Cocoa Farms

Land Size(Acres)	Frequency	Percentage	Cum. %
Less than 5	54	27.2	27.2
5 - 10	78	39.2	66.4
11 – 15	32	16.1	82.5
16 – 20	13	6.5	89.0
21– 25	8	4.0	93.0
26- 30	5	2.5	95.5
More than 30	9	4.5	100.0
Total	199	100.0	-

n=200. Source: Field Survey Data, 2006.

$\bar{X}$ =10.5, SD=10.0, Mode=4, Min=1, Max = 68

The size of land, to some extent, affects the yield of the farmer, all other things being equal. However, farmers who benefited from the CHTP received the same quantities (6 bags for each farmer for 2 acres) of fertiliser and other inputs irrespective of the size of their farms. It, therefore, follows that the size of farm may not have affected the yield of farmers in the study area. The exception may be those farmers who used the input on more or less than the 2 acres they were expected to be used. In that case, such farmers may get less than the yield they would have obtained per acre.

Land Size used for the CHTP

Under the programme, beneficiary farmers were to demarcate two (2) acres of cocoa farm where the input supplied to them would be applied. The

researcher wanted to find out if beneficiary farmers followed the instruction of using the inputs (fertilisers, fungicides and insecticides) for the required two (2) acres of land.

Table 52: Acreage of Land used by farmers for the CHTP

Land size	2003		2004		2005	
(acres)	f	%	f	%	f	%
1	1	0. 5	1	1.0	-	-
2	178	89.4	83	86.5	74	85.1
More than 2	20	10.1	12	12.5	13	14.9
Total	199	100	96	100	87	100
	$\bar{X}$ =2.3		$\bar{X}$ =2.4		$\bar{X}$ =2.5	
	SD=0.9		SD=1.6		SD=1.7	
	Max=8		Max=15		Max=15	

n=200. Source: Field Survey Data, 200

The Table 52 presents frequencies, percentages, means and standard deviations of the sizes of cocoa farms where the CHTP was implemented for the three (3) -year period (2003 to 2005).

Table 52 reveals that majority of the farmers (ranging from 85% to 89%) used the inputs on the 2 acres of cocoa farm, which is the prescribed land size for the CHTP. The average acres of land used by farmers were between 2.3 to 2.5 over the three year period. About 11% to 15% did not apply the inputs on the recommended two (2) acres of cocoa farm. Some farmers (approximately 10%-15%) even went to the extent of applying the inputs on 8 to 15 acres of cocoa farms (Table 52).

The implication is that since these farmers did not use the recommended rate of application of the fertilisers, insecticides and pesticides, this may have affected significantly the yields expected. Another implication is that the misuse of the inputs could also have detrimental effects on insects and their environments. For example, those who over-applied (use the inputs on less than 2 acres) especially the insecticides and fungicides may results in harmful effect on other organisms and insects in the environment. On the other hand, under-application (used on more than 2 acres cocoa farm) of the inputs, especially, the insecticides and fungicides may not be able to destroy the insect and fungus because the doses are not enough to destroy or reduce the population significantly.

Pidwirny (2002) has also reported that up to 90 % of the pesticides applied never reached the intended targets and, as a result, many other organisms sharing the same environment as the pests were accidentally poisoned.

The results in the Table 52 also show that the number of farmers who applied or adopted the programme reduced form the 2003 to 2005. For example, out of the 200 respondents, who adopted the programme in the first year (2003), only about half (96) continued for the 2004 season and less than half (87) continued to apply the programme in 2005. Also the percentage of farmers, who applied the inputs on the recommended two (2) acres reduced over the three (3) year period. For example, in the first year of adoption (2003), 89.4% of farmers applied inputs on recommended acreage of land. The percentage decreased to 86.5 in 2004 and further decreased to 85.1 in 2005. Though the rate of decrease over the years may not have been significant, it is

noteworthy that some farmers may not have been made to know the full implications of misapplying the inputs or if they knew, some of them just chose to misapply it.

Yields of Farmers under the CHTP over 4-Year Period (2002-2005)

Table 53 presents the estimated yield of cocoa farmers between 2002 and 2005 on the two (2) acres of land they demarcated for the CHTP.

The first column of Table 53 shows the frequency distribution as well as means of respondents' estimated yield in 2002, a year before the CHTP commenced. It reveals that majority, approximately 60% of the 186 respondents who were able to provide information on their yields, had five (5) or less bags of cocoa per two (2) acres of cocoa farms (i.e. 2.5 bags/acre). About 40% had yields more than 5 bags per 2 acres of land. Only few farmers (19 out of 186) representing about 10% had more than 10 bags of cocoa beans per two acres. The mean yield was 5.7 bags per 2 acres (2.85 bags/acre). Appiah (2004a) also reported 3-5 bags/acre of farms where CHTP was not applied.

In 2003, a year after farmers adopted the CHTP, about 75 % had more than 5 bags of cocoa beans per the 2 acres of land demarcated for the programme. This was about 36 % over the previous year when farmers had not yet started the programme. The maximum yield recorded in 2003 was 39 bags (19.5 bags/acre). Also about 30% had more that 10 bags/2acres. The average yield recorded in 2003 was 9.5 bags/2acres (4.75 bags/acre).

Table 53: Yield of Cocoa Farmers over 4-Year Period (2002 – 2005)

Yield (bags/2acres)	2002		2003		2004		2005	
	f	%	f	%	f	%	f	%
5 or less	111	59.7	46	24.7	38	26.6	7	18.9
6-10	56	30.1	84	45.2	69	48.2	16	43.3
11-15	11	5.9	34	18.2	23	16.1	8	21.6
16 – 20	6	3.2	15	8.1	5	3.5	-	-
More than 20	2	1.1	7	3.7	8	5.6	6	16.2
Total	186	100	186	100	143	100	37	100
	$\bar{X}$ = 5.7		$\bar{X}$ = 9.5		$\bar{X}$ = 9.0		$\bar{X}$ =11.8	
	SD=4.5		SD= 6.2		SD= 7.1		SD=8.3	
	Min=0.5		Min= 1		Min= 1		Min=3	
	Max=25		Max=39		Max=45		Max=40	

n=200 Sources: Field Survey Data, 2006

Appiah (2004a) again reported an average of 10 bags or more/acre of fields where CHTP was applied. If the average yield of this study is compared to that of Appiah, the yield is almost half of that of Appiah (2004a). However, it is noteworthy that very few farmers (7) recorded more than 10 bags/acre and one farmer recorded 19.5 bags/acre which agrees with the findings of Appiah (2004a). Though the yield after the programme lower than expectatrd, when the average yield per acre in 2002 (2.85 bags/acre) was compared to that of 2003 (4.75 bags/acre) it revealed an appreciable increase of about 67% between 2002 and 2003, a year after the implementation of the CHTP.

In 2004, an average of 9 bags/2acres (4.5 bags/acre) was recorded which was 0.5 bag less than that of 2003. The percentage of farmers who

recorded between 6-10 bags/2acres, however, increased from approximately 45% to 48%. There was also an increase from 3.7% to 5.6% for farmers who recorded yield more than 10 bags/acre. Though there was a reduction in average yield between 2003 and 2004, there was an increase in yield when that of 2002 (2.85 bags/acre) was compared with 2004 (4.5 bags/acre).

In 2005 (three years after the application of CHTP), few respondents (37 out of 200) were able to provide information on the status of their yields. Nevertheless, an average of 11.8 bags/2 acres (5.9 bags/acre) was recorded. Though this may not have been the true reflection of all respondents as shown by a relatively higher standard deviation of 8.3 (coupled with few respondents), it is again noteworthy that when the average yield in 2005 was compared to that of 2002 (2.85 bags/acre), it was approximately doubled. Appiah et al. (1997) have extrapolated from their field trials that the national production could be doubled within a four-year period if fertilisers are applied.

The trend in yields actually shows an increase over the 3 year period and notably between 2002 (before farmers started CHTP) and the each year after the implementation of the programme. The relatively lower increase in yield as expected under the programme could have been as a result of how well each farmer followed the instructions of the CHTP. Also, differences in yield could have been as a result of the availability of rainfall during the implementation of the CHTP especially the application of the fertiliser. The fact that few farmers recorded the expected yield of 10 or more bags/acre also seems to indicate that the target of the programme can be achieved under favourable conditions and effective implementation of the programme.

Dependent t-test of Yields of Farmers Before and After the CHTP

The Table 54 provides the dependent sample t-tests of farmers' yields before (2002) and after (2003 and 2005) the CHTP.

Table 54: Dependent (Paired) Sample t-test of Estimated Yield of Farmers Before and After the CHTP

Years	n	$\bar{X}$ yield (bags/2 acres)	SD	MD	t ratio	Sig.
2002	186	5.7	4.5	3.8	11.36	0.000*
2003	186	9.5	6.2			
2002	186	5.7	4.5	3.3	7.76	0.000*
2004	143	9.0	7.1			
2002	186	5.7	4.5	0.5	9.72	0.000*
2005	37	11.8	8.3			
2002	186	5.7	4.5	4.1	11.32	0.000*
2003 -2005	186	9.8	6.7			

***p< 0.05** n =200 Sources: Field Survey Data, 2006

The results depicted Table 54 shows that there was statistically significant (0.000) difference between the mean yield of cocoa farmers in 2002 ($\bar{X}$ =5.7, SD=4.5) and 2003 ($\bar{X}$ =9.5 SD=6.2) at 0.05 alpha level (i.e. one (1) year after the adoption of the CHTP. The Table 54 also shows that there were also statistically significant (0.000) differences between the mean yield of cocoa farmers in 2002 ($\bar{X}$ =5.7, SD=4.5) and 2004 ($\bar{X}$ =9.0 SD=7.1) at 0.05 alpha level, i.e. two (2) years after the adoption of the CHTP. There

was again significant (0.000) difference between the mean yield of cocoa farmer in 2002 ($\bar{X}$ =5.7, SD=4.5) and 2005 ($\bar{X}$ =11.8 SD=8.3) at 0.05 alpha level (i.e. three (3) years after the adoption of the CHTP).

Means were computed for the yields between 2003 to 2005 (after the implementation of the CHTP) and an average of 9.8 bags/2 acres was realized showing an average increase of 4.1 bags/2acres compared to that of 2002. The dependent t-test before (2002) and after (means from 2003 to 2005) the programme also showed that there were statistically significant (0.000) differences between the mean yield of cocoa farmers before ($\bar{X}$ =5.7, SD=4.5) and after ($\bar{X}$ =9.8 SD=6.7) the adoption of CHTP at 0.05 alpha level. The third (3^{rd}) null hypothesis which stated that "there is no significant difference in the estimated yields of farmers before and after the adoption of the programme" was rejected. The alternative hypothesis was, therefore, accepted.

The implication is that the CHTP significantly improved the yields of cocoa farmers though the improvement in yields as discussed earlier was below expectation of the programme.

Relationship between the Perceived Impacts of the CHTP on Livelihood and Farmers' Perceived Effectiveness of the CHTP

Pearson product-moment correlation co-efficients (r) showing relationships between perceived impact of the CHTP and the perceived effectiveness of the five (5) main components of the programme (cultural maintenance, fertiliser application, fungicides application, insecticides application and harvesting and post-harvest technologies) are presented in Table 55.

Table 55: Pearson Correlation Matrix of Perceived Impact on Livelihood and the Effectiveness of the Five (5) Main Components of the CHTP

Variables	Y	X_1	X_2	X_3	X_4	X_5
Y	-					
X_1	**0.573****	-				
X_2	**0.667****	0.653**	-			
X_3	**0.666****	0.664**	0.779**	-		
X_4	**0.587****	0.718**	0.642**	0.703**	-	
X_5	**0.639****	0.794**	0.632**	0.645**	0.704**	-

Source: Field Survey Data, 2006 *p < 0.05 (2-tailed). **p< 0.01 (2-tailed)

Y= Perceived impact on livelihoods.

X_1 =Cultural maintenance

X_2 =Fertiliser Application

X_3 =Fungicide Application

X_4 =Insecticide Application

X_5 =Harvesting, fermentation and drying technologies

The Pearson product-moment correlation co-efficients presented in the Table 55 show that there were direct (positive) and substantial significant relationships between the farmers' perceived impact on livelihood and the effectiveness of each of the five (5) main components of the CHTP even under 0.01 alpha level. That is, direct and substantial significant relationship between impact on livelihoods and effectiveness of cultural maintenance component (r=0.573); direct and substantial significant relationship between impact on livelihoods and effectiveness of fertiliser application component

(r=0.667); direct and substantial significant relationship between impact on livelihoods and effectiveness of fungicides application component (r=0.666); direct and substantial significant relationship between impact on livelihoods and effectiveness of 'insecticides application component' (r=0.587); and finally direct and substantial significant relationship between impact on livelihoods and effectiveness of 'harvesting, fermentation and drying technology component' (r=0.639) of the CHTP.

The fourth (4^{th}) null hypothesis which stated that "there is no significant relationship between perceived impact of the CHTP on farmers' livelihoods and farmers perceived effectiveness of each of the five (5) main components of the CHTP" was rejected. The alternative hypothesis was therefore accepted.

Consequently, the more farmers perceived each of the five components to be effective, the more they perceived that each component enhanced their livelihoods. The implication of the relationships is that each of the five components was important in enhancing the livelihoods of cocoa farmers who adopted the CHTP. For example, the application of fertiliser increased the yields of farmers and when prices are favourable, the income of farmers would be increased thereby improving their livelihoods. Similarly, the other four (4) components are equally and significantly important in improving the livelihoods of farmers.

Predictors of Perceived Impact of CHTP on Farmers' Livelihoods

All the five (5) major components of the CHTP were used to determine the best predictor(s) of impact on livelihoods of farmers because they all had

significant relationship with the farmers' perceived impact on their livelihoods (Table 55). Also, Collinearity (also called multicollinearity) tests showed that there was no significant collinearity (linear relationships among the independent variables) that could bias the prediction; hence all the five (5) independent variables (the 5 main components of CHTP) were used for the prediction. Gupta (2000) stated that significant collinearity exist between independent variables if:

i. correlation co-efficient between any two variables is greater than 0.8 (in absolute terms) and

ii. R-squared is greater than 0.75 and only few t- values are significant.

From the correlation matrix in Table 55, and the R-squared and t-value significance in Table 56, it can be observed that that there was no significant collinearity that may bias the prediction, hence all the five (5) predictors were used for the prediction (i.e. correlations are less than 0.8, R-squared is less than 0.75 and all t-values of the beta are significant).

Table 56: Collinearity Diagnostic Test

Independent Variables	R-squared	t- values of the Beta	Sig.
Constant	-	3.277	0.001*
Fertiliser Application	0.488	3.698	0.000*
Harvesting, fermentation & drying	0.542	3.681	0.000*
Fungicide Application	0.563	2.885	0.004*

n=200 *p<0.05 Source: Field Survey Data, 2006

Table 57 presents a stepwise regression of the effectiveness of the main components of the CHTP on perceived impact on livelihoods. The results in Table 57 indicate that three (3) out of the five (5) independent variables used for the prediction accounted significantly for farmers perceived impact of CHTP on their livelihoods. These three (3) best predictor variables were: farmers' perceived effectiveness of (1) fertiliser application; (2) fungicide application; and (3) harvesting, fermentation, and drying components of the CHTP.

Table 57: Stepwise Regression of Main Components of CHTP on Impact on Livelihoods of Cocoa Farmers

Predictors	Step of Entry	Beta (standardised)	R^2	Adj. R^2	Adj. R^2 Change	S.E.E	F Reg.	F. Sig*
X_2	1	.327	.488	.486	.486	.462	166.17	.000
X_5	2	.259	.542	.536	.050	.438	102.19	.000
X_3	3	.248	.563	.555	.019	.429	73.79	.000

n=200 ***p<0.05** Source: Field Survey Data, 2006

Dependent Variable (Y) = Perceived impact on livelihood

X_2=Fertiliser Application

X_3=Fungicide Application

X_5=Harvesting, Fermentation and Drying technologies

Regression Equation (from unstandardised Beta)

$Y = 0.657 + 0.264 X_2 + 0.186 X_3 + 0.237 X_5$

$Y = 0.657$ if $\beta_2 = \beta_3 = \beta_5 = 0$

It was observed that these three (3) components together accounted for a total of 55.5% of all the variance in farmers' perceived impact of the CHTP on their livelihoods (Refer to the last role of adjusted R^2 column in Table 57). The amount of contribution each of the three components made towards the 55.5% variance in the farmers' perceived impact on livelihood is shown in the "Adjusted R^2 Change" column in Table 57. Farmers' perceived effectiveness of fertiliser application was the overall best predictor, accounting for 48.6% of the variance in farmers' perceived impact of the programme on livelihoods. Farmers' perceived effectiveness of harvesting, fermentation and drying technologies was next contributing 5% in explaining the variance in farmers' perceived impact on livelihoods. This was followed by their perceived effectiveness of fungicide application which accounted for only 1.9% in explaining the variance in perceived impact of the programme on their livelihoods. The individual values of the Standard Error of Estimate (S.E.E) also showed relatively high accuracy of prediction in the regression model.

The first overall best predictor (fertiliser application) which accounted for the highest (48.6%) explanation in impact on farmers' livelihood happened to be the main trust of the CHTP. The implication is that application of fertiliser directly affects yield and income of cocoa farmers which will consequently improve their livelihood. Edwin and Masters (2003) also reported from survey done in Ghana that the use of fertiliser is associated with 21 percent higher yields. It can be deduced, therefore, that relative increase in yield as a result of the application of fertiliser can go contribute significantly to improve or enhance the livelihoods of farmers.

Farmers' perceived effectiveness of harvesting, fermentation and drying technologies component of the programme was the second variable in the step of entry, which accounted for 5% variance in the perceived impact on livelihoods. This is very understandable because even if farmers had very high yields as a results of the application of fertiliser and other inputs but they do not follow the appropriate technologies recommended for harvesting, fermentation and drying, the quality of the beans would be affected and may not meet the minimum standard in the world market and such beans tend to be rejected. For example, Takrama (2006) reported that though the recommended fermentation period is 6-7 days after opening and turning of the beans in heap at 48 and 96 hours interval, most farmers still use 3-5 days fermentation period. Under the CHTP, farmers were to use 6-7 days to ferment their cocoa beans. Results from the study already discussed in Table 18 show that about 88% of the respondents used the recommended period of fermentation. The implication is that the beans produced were of the expected quality and, therefore, were not rejected at the buying centres.

The variable in the third step of entry was perceived effectiveness of the fungicide application component of the programme. Though it accounted for only 1.9% in the prediction, it is also noteworthy that the control of black pod disease (through the use of the recommended fungicides) resulted in significant reduction of *Phytophthora* infestation thereby reducing the destruction by the fungus and, consequently, contributing to the increase in yield

To conclude the discussion on the regression results, it is worthy to note that the perceptions of farmers have revealed that fertiliser application:

harvesting, fermentation and drying technologies; and fungicide application were the best predictors of impact of the CHTP on the livelihoods of cocoa farmers in the study area. CRIG and MoFA should be guided by these best predictors (especially, fertiliser application component) in enhancing the effectiveness of the CHTP in the Eastern Region of Ghana

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

General Overview

This chapter presents the summary, conclusions and recommendations of the study. It also presents suggested areas for further studies.

Summary

Cocoa is the dominant tree crop in Ghana, accounting for 20.5% of Ghana's export earnings, 3.3% of GDP and the sub-sector employs 24% of labour force (FASDEP, 2002). It also accounts for 55% of the total household income among cocoa farmers in Ghana (IITA, 2002).

CRIG found out that the relatively low level of production in Ghana (350 kg/ha) compared to Cote d'Voire (800 kg ha) and Malaysia (1700 kg ha) was as a result of high incidence of pests and diseases, decline in soil fertility and erratic rainfall pattern (Appiah, 2004a). The Cocoa High Technology Programme (CHTP) was, therefore, implemented by the Government of Ghana in 2003 to solve most of the aforementioned problems with the emphasis on increasing the fertility of the soil. Farmers' perceptions on the impact of the programme on various facets of their livelihoods have not been examined in various cocoa regions that adopted the programme and Eastern Region was no exception. This study, therefore, attempted to examine the

perceived impact of the CHTP on the livelihoods of cocoa farmers in the Eastern Region of Ghana.

Specifically, the study was guided by the following objectives to:

1. find out perceptions of farmers on the effectiveness of the main components of the CHTP namely:
    - Cultural Maintenance,
    - Application of fertiliser,
    - Application of fungicides,
    - Application of insecticides, and
    - Harvesting, fermentation and drying technologies.
2. examine the level of perceived impact of the CHTP on the livelihoods of cocoa farmers with respect to the following:
    - Natural capital,
    - Physical capital,
    - Financial capital,
    - Human capital, and
    - Social capital.
3. compare the level of perceived impact of the programme on farmers' livelihoods among the four (4) districts of the study area.
4. find out farmers' perceptions about the weaknesses and strengths of the programme and how the problems may be solved.
5. compare the level of perceived effectiveness of the programme between male and female cocoa farmers.
6. examine the following demographic and farm related characteristics of cocoa farmers, namely, age, educational level, years of experience,

household size, size of cocoa farm, number of cocoa farms and yield of farmers.

7. compare the estimated yield of cocoa farmers before and after they adopted the CHTP.
8. explore relationships between the farmers' perceived level of effectiveness of the main components of the CHTP and perceived impact on livelihoods of farmers.
9. identify the best predictor(s) of impact of the programme on livelihood from the main components of the CHTP.

Descriptive correlational survey was used to interview 200 cocoa farmers, who adopted the CHTP from four (4) districts in the Eastern Region of Ghana. Measures of central tendency and dispersion, frequencies and percentage distributions, dependent and independent t-tests, analysis of variance (ANOVA) post-hoc multiple comparison, Pearson product-moment correlation co-efficients, and stepwise multiple regression were the statistical tools used to analyse the data. The summary of major findings as they relate to the specific objectives of the study was as follows:

Perceived Effectiveness of the Main Components of CHTP

The results of the study revealed that about 83%, 99%, 74%, 89% and 88% of the respondents implemented respectively, the various sub-components of the CHTP namely (1) cultural maintenance, (2) fertiliser application, (3) fungicide application (4) insecticides application, and (5) harvesting, fermentation and drying technologies. There was an exception in

one of the sub-components of the 'fertiliser application component' (Application of the fertiliser at the beginning of the raining seasons) where only approximately 42% of respondents performed.

The majority of the respondents, who implemented the components of the programme (ranging from 38% to 87%), perceived the various components to be at least 'effective' resulting in increases in their yields and incomes as they anticipated from the programme. A sizable proportion of respondents ranging from 13% to 57% also perceived the various components to be 'moderately effective' (i.e. the effectiveness was below their expectation). Very few respondents perceived that the components of the programme were either ineffective (ranging from 0.5% to 15 %) or 'very ineffective' (ranging from 0.5% to 1.5 %) and therefore to them, the CHTP failed to improve their yield or income.

Generally, all the five (5) main components of the CHTP were perceived to be effective (means ranging from 3.61 to 4.04). However, the harvesting, fermentation and drying component ($\bar{X}$ = 4.04, SD=0.66) was the most effective component of the programme as perceived by respondents. It was followed by insecticide application, ($\bar{X}$ = 3.85, SD=0.78) cultural maintenance ($\bar{X}$ = 3.79, SD=0.71), fertiliser application $\bar{X}$ = 3.76, SD=0.83) and fungicide application ($\bar{X}$ = 3.61, SD=0.86) in that order. Respondents perceived the CHTP, as a 'whole', to be 'effective' ($\bar{X}$ = 3.81, SD=0.66) in improving their yields and income and they were consistent with their views.

Perceived Impact of the CHTP on the Livelihoods of Cocoa Farmers

The results of the study also revealed that the majority of the farmers claimed that the programme improved all the five (5) main facets of livelihoods examined namely natural, physical, financial, human and social capitals.

About 95% to 99% of the respondents perceived that various facets of natural capital (which included yield, productivity and quality of cocoa beans) were improved by the programme. With respect to physical capital (which included access and ownership of equipment such as sprayers, prunners and harvesters), a wide range of respondents (27% to 92%) perceived that the programme was able to improve that aspect of their capital or livelihood. The most important sub-facet of financial capital that was examined was the 'increase in income' of respondents. The results again showed that about 92% of the 200 respondents claimed that the programme resulted in increase in their income and therefore about 88% were able to pay back their credits either in full or in part. Due to this only 41% were able to save part of their income.

Few respondents (19%) were able to enhance their access to credit facility. About 68 to 92 percent perceived that various sub-facets of their human capital (which included access to both skilled and unskilled labour as well as public extension) were improved due to the CHTP. Only 2% had access to private extension service as a result of the programme. Many sub-components of social capital (which included ability to feed family members, pay school fees, support friends) were improved as a results of the programme. About 51% to 97% claimed that they were able to meet these social

obligations as a result of the programme. Few respondents (14.5%), however, claimed that they were able to join and benefit from farmers' associations/groups due to the programme.

Farmers, who responded that the CHTP had improved the various facets of their livelihoods, however, had varied views as far as the level of impact was concerned. A wide range of those respondents (20% to 71%) perceived that the level of impact of the CHTP on various facets of their livelihoods examined were 'moderately high' (i.e. not as high as they anticipated). Also a range of 11% to 64% of the farmers perceived that the level of impact on various facets of their livelihoods was at least as 'high' as they anticipated. Few farmers perceived that the impact was low or very low.

The results from the mean perceived impact showed that farmers generally perceived impact on physical ($\bar{X}$ = 3.51, SD=0.81), and natural ($\bar{X}$ = 3.51, SD=0.84), capital to be 'high', however, their views were quite inconsistent. They also perceived that impact on the other three (3) facets of livelihoods namely financial capital ($\bar{X}$ = 3.27, SD=0.88), human capital ($\bar{X}$ = 3.27, SD=0.88) and social capital ($\bar{X}$ = 3.02, SD=0.62) was 'moderately high'. The programme, therefore, improved the two immediate aspects of livelihood (natural and physical) more than the rest. The least impacted facet of livelihood examined was the social capital. This showed that increases in yield do not automatically translate to improvement in other aspects of farmers' livelihood, especially social capital.

Generally, respondents perceived that impact of the programme on their 'overall' livelihoods was 'moderately high' ($\bar{X}$ =3.32, SD=0.66)

implying that the level of impact though high, was not as high as they anticipated.

Level of Impact of the CHTP on Livelihoods of Farmers in the Four Districts of the Study Area

The results showed that the level of perceived impact of the CHTP on the livelihood of farmers in the four (4) districts varied. While the level of impact was perceived by respondents in the Fanteakwah ($\bar{X}$ = 3.99, SD=0.63) and Birim North ($\bar{X}$ = 3.60, SD=0.44) to be 'high', that of Birim South ($\bar{X}$ = 3.20, SD=0.63) and East Akim ($\bar{X}$ = 2.81, SD=0.48) districts was perceived to be 'moderately high'. Impact was found to be highest in Fanteakwah District and least in East Akim District among the four (4) districts studied in the Eastern Region.

An analysis of variance (ANOVA) of the mean perceived impact on livelihoods among the four districts showed that statistically significant (0.000) differences existed among the perceived impact observed at 5% confident interval. A multiple comparison (using Tamhane's T2 test) also revealed that significant differences existed among the mean differences in each of the four districts studied at 0.05 alpha level (i.e. between Birim South and East Akim; Birim South and Fanteakwah; Birim South and Birim North. Also East Akim and Fanteakwah; East Akim and Birim North; and Fanteakwah and Birim North).

Strengths, Problems Encountered and Suggested Solutions to the Problems of the CHTP

The study again revealed that the two (2) main strengths of the programme were the fertiliser and insecticide application components. Eighty (80%) percent of respondents agreed that the main strength of the programme was the fertiliser application component.

The major problems that farmers encountered during the implementation of the CHTP were:

- late arrival of fertiliser.
- high cost of weeding due to faster growth of weeds as a results of the fertiliser application.
- inadequate training, supervision and monitoring by AEAs.
- unavailability of spraying machines.
- high cost of inputs, difficulty in transportation of inputs especially fertiliser to their farms and, and
- difficulty in getting labour for weeding.

Farmers' responses, however, showed that the major problems that they faced (in decreasing order of importance or severity of the problem) were late arrival of fertiliser (49.5%) high cost of weeding due to faster growth of weeds as a results of the fertiliser application(44.5%), inadequate training, supervision and monitoring by AEAs (20.5%) and unavailability of spraying machines(18.5%).

Farmers also made suggestions as to how the problems could be solved or minimized. These included, timely supply of fertiliser, supply of weedicides as part of the package of the CHTP, provision of soft loan to farmers by the

government for cultural maintenance of their farms (especially weeding), supply of spraying machine, regular visits and supervision of AEAs, and reduction in the cost of inputs supplied to farmers under the CHTP.

Differences in Male and Female Perceived Effectiveness of the CHTP

Generally, both male and female respondents had similar views about the effectiveness of the programme. The mean perceived effectiveness of the CHTP computed revealed that both male and female perceived the programme to be 'effective' and, therefore, met their expectation. An independent sample t-test conducted showed that there were no statistically significant (0.63) differences between the perceptions of females and males about the effectiveness of the programme under 0.05 alpha level.

Demographic and Farm Related Characteristics of Cocoa Farmers

The study reveled that farmers in the study area are aging. About 64% of the respondents were at least 50 years. The average age of farmers was 56 years. The minimum and maximum ages were 24 and 106 years respectively.

The study further showed that 80% of the respondents had some form of formal education. More than half (54.6%) of the farmers had middle school level of education indicating that the majority had low education. Few farmers (3.1%) had tertiary education.

Also about 94% of the respondents had at least 10 years farming experience as cocoa farmers. Half of the farmers (51.8%) had been cocoa farmers for 20 to 49 years. The mean years of experience of cocoa farmers in the study area was 24.

The study again revealed that 70% of the respondents had 5–10 members in their households. While 5.8% had household size below five (5). three (3) percent had more than 15. The mean household size was nine (9).

The majority of the farmers owned one (35.9%) or two (40.9%) cocoa farms. About 90% of the respondents owned between 1 to 3 cocoa farms. Respondents owned an average of two (2) cocoa farms.

With respect to the age of cocoa farm where the CHTP was implemented, about 70% of the respondents implemented the CHTP on cocoa farms with trees less than 30 years. The mean age of cocoa trees in the study area where the technology was applied was approximately 24 years with a minimum and maximum of 4 and 60 years respectively.

Furthermore, the study indicated that about 66% of the farmers had 10 or less acres of total land size under cocoa cultivation. The average size of land under cocoa cultivation was 10.5 acres (4.2 ha). However, further investigation revealed that the majority (85% to 89%) of respondents used the inputs on the 2 acres of cocoa farm recommended under the CHTP. The average acres of land used were 2.3 to 2.5 over the three year period. About 11% to 15% of the respondents did not apply the inputs on the recommended two (2) acres of cocoa farm within the three year period (2003 to 2005.

The study also investigated the yield of farmers before and after the implementation of the CHTP. The results revealed that a year (i.e. in 2002) before the implementation of CHTP, 60% of farmers interviewed had 5 bags or less per 2 acres of land. About 40% of farmers interviewed had yields more than 5 bags per 2 acres of land. Only few farmers (19 out of 186) representing

about 10% had more than 10 bags of cocoa beans per 2 acres. The mean yield was 5.7 bags per 2 acres (2.85 bags/acre).

A year after the implementation of the CHTP (i.e. 2003), about 62% of the respondents recorded more than 5 bags of cocoa beans per the 2 acres (about 22% over the previous year when farmers had not yet started the programme). The maximum yield recorded in 2003 was 39 bags/2acres (19.5 bags/acre). The average yield was 9.5 bags/2acres (4.75 bags /acre), which is about 67% increase over that of 2002.

In 2004, an average of 9 bags/2acres (4.5 bags/acre) was recorded which was 0.5bag less than that of 2003. There was also an increase from 3.7% to 5.6% of farmers who recorded yield of more than 10 bags/acre. Though there was a reduction in average yield from 2003 to 2004, there was an increase in yield when that of 2002 (2.85 bags/acre) was compared with 2004 (4.5 bags/acre). In 2005, few farmers (37 out of 200) were able to provide information on the status of their yield. They recorded an average of 11.8 bags/2 acres (5.9 bags/acre).

Yields of Farmers Before and After the CHTP

Dependent sample t-test conducted also confirmed that there were significant differences in yield before and after the implementation of the CHTP. Statistical significant (0.000) difference was found between the mean yield (bags) per 2 acres of cocoa farm in 2002 ($\bar{X}$ =5.7, SD=4.5) and 2003 ($\bar{X}$ =9.5 SD=6.2); 2002 ($\bar{X}$ =5.7, SD=4.5) and 2004 ($\bar{X}$ =9.0 SD=7.1); and 2002 ($\bar{X}$ =5.7, SD=4.5) and 2005 ($\bar{X}$ =11.8 SD=8.3) at the 0.05 significant level. Statistically significant difference also existed between mean yield in

2002 ($\bar{X}$ =5.7, SD=4.5) and that of the overall average of the three years (2003 to 2005) ($\bar{X}$ =9.8 SD=6) after the programme. The trend showed a significant improvement in the yields of cocoa farmers after the implementation of the programme though below the target of CHTP.

Relationship between the Perceived Impact on Livelihoods and Farmers' Perceived Effectiveness of the Components of the CHTP

Pearson product-moment correlation co-efficients (r) also revealed that there were **direct (positive)** and **substantial** significant relationships between the farmers' perceived impact on livelihood and the perceived effectiveness of each of the five (5) main components of the CHTP (even under 0.01 alpha level), namely, cultural maintenance(r=0.573), fertiliser application (r=0.667), fungicide application (r=0.666), insecticide application (r=0.587) and harvesting and post-harvest technologies (r=0.639). This implied that all the five components of the CHTP were important in enhancing the livelihoods of farmers who adopted the programme.

Best Predictors of Perceived Impact of CHTP on Farmers' Livelihoods

Stepwise multiple regression was used to determine the best predictors of perceived impact on livelihood (dependent variable) from the perceived effectiveness of the five (5) components of the CHTP (the independent variables). Results from the prediction revealed that three (3) of the components namely (1) fertiliser application, (2) fungicide application, and (3) harvesting, fermentation, and drying technologies were the best predictors, and

the three (3) components together accounted for a total of 55.5% of all the variance in farmers' perceived impact of the CHTP on their livelihoods.

The overall best predictor was fertiliser application component accounting for 48.6% of the variance in farmers' perceived impact on livelihoods. It was followed by harvesting, fermentation, and drying technologies component and fungicide application component accounting for 5% and 1.9% respectively in the explanations of variances in the dependent variable.

The implication is that there is the need for CRIG and MoFA should pay attention to these three (3) best predictor variables in efforts to enhance the livelihood of farmers under the programme.

Conclusions

The following conclusions were drawn from the study:

1. The majority of the farmers (ranging from 74% to 88%) implemented all the five components as well as the sub-components of the programme. The exception was with the timely application of fertiliser where only 42% of the respondents were able to do so.
2. Generally, farmers perceived (each of the five main components as well as the 'whole' programme) to be effective in increasing their yields and incomes and there was fairly high degree of consistency in their views.
3. Farmers in the study area perceived the harvesting, fermentation and drying component to be the **most effective** component of the programme. This was followed by insecticide application, cultural

maintenance, and fertiliser application and fungicide application components in that order.

4. Most of the farmers in the four districts were able to improve, to some extent, all the five facets of their livelihoods examined (natural, physical, financial, human and social capitals). A range of 95% to 99%, 27% to 92%, 68% to 92% and 51% to 97% claimed that their natural, physical, human and social livelihoods respectively have been improved as a result of the programme.
5. The majority (92% of 200 respondent farmers) were able to increase their income as results of the programme. However, few less than half (42%) were able to save some of the income generated. Most (88%) of them used the income to settle their debts or pay back part or all the credit they obtained under the CHTP. Few (19%) were able to access credits as results of the programme.
6. A wide range (11% to 64%) of the respondents whose livelihoods were improved perceived that the level of impact on various facets of their livelihood was as 'high' as they anticipated. About 20% to 71% claimed that the level of impact was not as high as they anticipated. Few farmers had low impact of the CHTP on their livelihoods.
7. Generally, the level of impact of CHTP on natural and physical livelihoods of farmers was high. Farmers, however, perceived that the level of impact on 3 other categories of livelihoods (financial, human, and social), though high, was not as high as they anticipated. The level of impact of the programme on livelihoods of farmers as a 'whole' though high, was below expectations of cocoa farmers.

spraying machines, high cost of inputs and difficulty in transportation of inputs especially fertiliser to their farms.

13. Suggestions to minimize or solve the problems encountered made by farmers were timely supply of fertiliser, supply of weedicides as part of the package of the CHTP, provision of soft loan to farmers by the government for cultural maintenance of their farms (especially weeding), supply of spraying machine, regular visits and supervision of AEAs, and reduction in the cost of inputs supplied to them under the programme.
14. Both male and female cocoa farmers perceived the programme to be 'effective' therefore meeting their expectations, though female respondents view the programme to be slightly effective than the male. The male to female ratio in the study area was 3:1
15. The farmers in the study area were aged and ageing. The majority of (64%) respondents were 50 years or more. The ages of respondents ranged between 24 and 106 years with a mean age of 56 years. This may have affected the task they are able to perform on their cocoa farms.
16. The study revealed 80% literate and 20 % illiterate farmers. The level of education was however low, since the majority (54.5%) possessed the Middle School Leaving Certificate. Very few farmers (3.1%) had tertiary education. Low level of education affected, to some extent, their ability to receive, decode, and understand information and also perform some of the tasks under the CHTP.

17. The farmers in the study area have rich working experience, averaging 24 years. The majority (94%) had at least 10 years of cocoa farming experience. Farmers' years of cocoa farming experience ranged between 3 to 70 years.
18. Seventy percent (70%) of the respondents had 5-10 members in their household. Households' size ranged between 1 and 26 members in the study area. The mean household size was nine (9). High members in household may provide readily available labour for farmers.
19. About 90% of the respondents owned between 1 and 3 cocoa farms. Respondents own an average of two cocoa farms. About 70% of the respondents applied the CHTP on cocoa farms with trees less than 30 years. The mean age of cocoa trees in the study area where the technology was applied was approximately 24 years with a minimum and maximum of 4 and 60 years respectively.
20. The majority (66%) had 10 or less acres of total land size under cocoa cultivation. The average size of land under cocoa cultivation was 10.5 acres (4.2 ha). A majority (85% to 89%) used the inputs on the 2 acres of cocoa farm recommended under the CHTP. About 11% to 15% did not apply the inputs on the recommended two (2) acres of cocoa farm within the three years (2003 to 2005) of the programme implementation.
21. Before the implementation of CHTP in 2002, the mean yield was 5.7 bags per 2 acres (2.85 bags/acre). A year after the implementation of the CHTP (2003), the average yield was 9.5 bags/2acres (4.75 bags/acre) - about 67% increase over that of 2002. In 2004, an average

of 9 bags/2acres (4.5 bags/acre) was recorded which was 0.5bag less than that of 2003. In 2005 an average of 11.8 bags/2 acres (5.9 bags/acre) was recorded.

22. The programme significantly improved the yields of farmers in the study area. Average farmers' yield increased by 72% three years after the implementation of CHTP of (from 2.85 bags/acre to 4.9 bags/acre), though the increase in yield was below the target of CHTP (10 or more bags/acre).
23. The projected targeted yield under the CHTP is attainable because some farmers (2 to 8) recorded the expected yield of more than 10 bags/acre.
24. All the five main components (cultural maintenance, fertiliser application, fungicide application, insecticide application, and harvesting, fermentation and drying technologies of the programme) correlated significantly (positive) and substantially with impact on livelihoods of farmers. All the five components are, therefore, important to the improvements in cocoa farmers' livelihoods.
25. The overall impact of CHTP on livelihoods of cocoa farmers cocoa farmers who adopted the programme in the Eastern Region is best predicted by fertiliser application; harvesting, fermentation and drying technologies; and fungicides application.
26. The overall best predictor of impact on livelihood of cocoa farmers who adopted the CHTP in the Eastern Region was fertiliser application accounting for 48.6 of variances in farmers' perceived impact on livelihoods.

Recommendations

Based on the conclusions of the study, the following recommendations were made for consideration to improve the effectiveness of the CHTP and its impact on cocoa farmers' livelihoods in the study area.

1. Cocoa Research Institute of Ghana (CRIG) and Purchasing Clerks (PCs) of various Licensed buying Companies (LBCs) involved in the CHTP should collaborate so that the fertiliser would be made available to beneficiary farmers promptly and before the beginning of the rainy season since late application of the fertiliser affects it effectiveness.
2. CRIG should investigate the feasibility of incorporating weedicides as one of the components of the CHTP.
3. The management should also consider making available knapsack and motorised spraying machines for cocoa farming communities which adopted the programme so that it would facilitate the fungicide and insecticide application components of the programme since most farmers did not have access to spraying machines. Participating farmers may be charged a fee for using the spraying machines in order to recover the cost and also maintain the use of the machines.
4. Various LBCs which registered participating farmers should consider also acquiring spraying machines for the cocoa farmers they register or sponsor so that they can alternate the use of these sprayers in their farms.They may also charge a moderate fee to ensure the sustainability of the use of the sprayers.
5. The management of the CHTP should collaborate with that of the Cocoa Mass Spraying Programme so that farmers can use the sprayers

since most farmers made use of the spraying machines under the Mass Spraying programme. The collaboration can also ensure that beneficiary farmers of the CHTP would make use of the trained personnel who are employed for the mass spraying programme.

6. AEAs selected to train cocoa farmers should place more emphasis on the application of fungicides and insecticides. Training should be given to farmers on measuring of agrochemicals, calibration of machines and safety precautions during spraying. Emphasis should also be placed on the harmful effect of using the recommended pesticides for the CHTP on vegetables and other crops.
7. Other people in the locality, apart from the AEAs, should be trained and employed to supervise and monitor the performance of the CHTP. These people should work hand in hand with the AEAs in the selected districts since AEAs are not able to monitor all participating farmers in addition to their main work that they do.
8. Since the CHTP is applied on only 2 acres of cocoa farms of beneficiary farmers', the management should consider increasing the inputs that would be able to cover more than 2 acres of farm to farmers who were able to pay back their credit.
9. Other stakeholders, such as LBCs, Rural banks and Cocoa Processing Companies, should also consider facilitating the adoption of the technologies involved in the CHTP and extend it to cocoa farmers through funding support. This is because the programme was able to increase significantly the yields and livelihoods of farmers who adopted it.

10. CRIG and other researchers (e.g. researches in University of Cape Coast and University of Ghana) who would want to improve the effectiveness of the CHTP and the livelihoods of cocoa farmers in the region should be guided by the best predictor variables (fertiliser application; harvesting, fermentation, and drying technologies and fungicide application) when developing and recommending technologies to cocoa farmers in the region. More emphasis should also be placed on the overall best predictor variable (fertiliser application).

Suggested Areas for Further Study

1. The study should be extended to other cocoa growing regions especially Western and Ashanti regions of Ghana.
2. Different impact assessment designs such as 'with and without' method be used to assess the impact of the CHTP on livelihoods.
3. The study should be repeated in the study area after some time to show the trend of effectiveness as well as impact of the programme on livelihoods.
4. Studies should also be conducted on the adoption of the CHTP in various cocoa regions.
5. Studies should also be conducted to compare the investment in the technology development effort to the value of the results, measured in terms of yield, income gains or rate of returns.

REFERENCES

Anandajayasekeram, P., Martella, D. R. & Rukuni, M. (1996). A Training Manual on R & D Evaluation and Impact Assessment of Investments in Agricultural and Natural Resources Research. SACCAR, Gaborone, Botswana.

Anandajayasekeram, P. & Martella, D. R. (1999). Evaluation of Agricultural Research in Eastern, Central, and Southern Africa. Knowledge, Technology, & Policy, 11, (4). pp. 13-41.

Appiah, M. R. (2004a). Impact of Cocoa Research Innovations on Poverty Alleviation in Ghana. Accra Printing Division, CSIR-INSTI.

Appiah, M.R. (2004b). Alleviating Rural Poverty in Cocoa Producing Areas of Ghana through Sustainable Cocoa Production. CRIG: Tafo, Ghana.

Appiah, M.R., Ofori-Frimpong, K., Afrifa, A.A. & Asante, E.G. (1997). Prospects of Fertilizer use in the Cocoa Industry in Ghana. Proceedings of the Soil Science Society of Ghana, 15, pp. 215-221.

Aryeetey, E. (2004). Household Asset Choice among the Rural Poor in Ghana. Proceedings of workshop for the Project on Understanding Poverty in Ghana. Institute of Statistical, Social and Economic Research (ISSER).

Asante-Mensah, S. (1988). The Adoption of Recommended Practices by Cocoa Farmers: The Ghana Cocoa Rehabilitation Program. Unpublished M. Phil Thesis, The University of West Indies, Department of Agricultural Extension, Faculty of Agriculture, St. Augustine, Trinidad and Tobago.

Baker, J. L. (2000). Evaluating the Impact of Development Projects on Poverty: A Handbook for Practitioners. The International Bank for Reconstruction and Development/The World Bank, Washington, D.C.

Bamberger, M. (2000). Integrating Quantitative and Qualitative Methods in Development Research. Washington, D.C.: The World Bank.

Becker, L. A. (1999). GLM for Single-Factor, Between- Subjects Designs, SPSS Base 9.0 Users Guide.

Bennett, C. F. (1979). Analyzing the Impact of Extension Programme. Science and Education Department, United State Department of Agriculture, Washington, D.C. pp.1-20.

Best, J.W. & Khan, J.V. (1998). Research in Education (8th-ed.). Needham Heights, MA, USA : Allyn and Bacon.

Bond, R., Kapondamgaga, P. H. & Ragubendra, P. S. (2003). Monitoring the Livelihood Platform: Reflections on the operation of LAST (The Livelihood Asset-Status Tracking). A Paper Presented at the New Directions in Impact Assessment for Development: Methods and Practice Conference, University of Manchester, 24-25 November, 2003.

Bond, R. & Hulme, D. (1992). A Review of the operations of the Opportunity Trust / Maranatha Trust, IDPM, University of Manchester.

Brokensha, D., Warren, D.M. & Werner, O. (1980). Indigenous Knowledge Systems and Development, Washington, D. C.: University Press of America.

Byrness, F. C. & Byrness, K.J. (1978). Agricultural Extension and Education in Developing Countries. Rural Development in a Changing World, pp. 54-67.

Carney, D. E. (1998). Sustainable Rural Livelihoods: What Contribution can we Make? Papers presented at DfID's Natural Resource Advisers Conference, July 1998.Department for International Development, London.

COCOBOD (2002). Report of the Committee on Application of High Technology Method on Cocoa Production in Ghana. Ghana Cocoa Board. Accra, Ghana. p. iv.

COCOBOD (2005). Cocoa Purchasing Between 2000 and 2004. Research Department, Ghana Cocoa Board, Accra.

Dankwa, J.B. (2002). Factors Affecting the Adoption Levels of Cocoa Technologies in the Ashanti Region of Ghana. Unpublished Master's Thesis. Department of Agricultural Economics and Extension University of Cape Coast, Cape Coast, Ghana.

Davis, J.A. (1971). Elementary Survey Analysis. Englewood, NJ:Prentice-Hall

Dizolele, M.(2005). Eye on Africa: Cocoa Market. Retrieved from the World Wide Web http:// www.globwalsecUritynews.com.

ECART / ASARECA / CTA (1999). Workshop on Impact Assessment of Agricultural Research in Eastern and Central Africa. Entebbe, Uganda, 16-19 November, 1999.

Edwin, J. & Masters, W. A. (2003). Genetic improvement and cocoa yields in Ghana. Department of Agricultural Economics, Purdue University, West Lafayette, Indiana, USA.

Ellis, F. (1998). Household Strategies and Rural Livelihood Diversification. Journal of Development Studies, 35 (1).

Ellis, F. (1999). Rural Livelihood Diversity in Developing Countries: Analysis, Methods, Policy. OUP.

Eponou, T. (1993). Partners in Agricultural Technology: Linking Research and Technology Transfer to Serve Farmers. International Service for National Agricultural Research. Research Report (1). The Hague: ISNAR.

Evanson, R .E. (1997). Extension, Technology and Efficiency in Agriculture in Sub-Saharan Africa. Handbook of Agricultural Economics.

FASDEP (2002). Food and Agriculture Sector Development Policy. Ministry of Food and Agriculture, Government of Ghana, Accra, p 57.

Gamble, T. K. & Gamble, M. (2002). Communication Works. (7th ed). New York: McGraw-Hill/Irwin, Inc, pp. 82-107.

Germanov, D., Meijer-Irons, J. & Carver, J. (2004). Evaluation and Impact Assessment. The Russia Micro-Project (56). A U.S Department of State NISCUP funded Partnership among the University of Washington-Evans School of Public Affairs, The Siberian Academy of Public Administration, and the Irkutsk State University. Retrieved on Web. http://depts.washington.edu/mfinance/eng/curriculum/index.html

Ghanaian Chronicle (April 22, 2004). Impact of Cocoa Research Innovations on Poverty Alleviation in Ghana. Ghanaian Chronicle, Accra. Posted to the web April 22, 2004.

Green S. B. & Salkind, N. J. (2000). Using SPSS for Windows: Analyzing and Understanding Data. Upper Saddle River, New Jersey: Prantice-Hall, Inc., pp. 160-162.

Gupta, V. (1999). SPSS for Beginners. Georgetown, Washington, D.C.: VJ Books Inc. p.190.

Gupta, V. (2000). Regression Explained. Georgetown, Washington, D.C.: VJ Books Inc. p.190.

http://www.ghanadistricts.com/region (2006). A Public - Private Partnership Programme between Ministry of Local Government, Rural Development & Environment & Maks Publications & Media Services .Retrieved on 2nd September, 2006 from the World Wide Web.

ICCO (2003). Annual Report of International Cocoa Organization for 2002/2003, 22 Berners Street, London, p.15.

IITA (2002). Summary of Findings from the Child Labor Surveys in the Cocoa Sector of West Africa: Cameroon, Côte d'Ivoire, Ghana, and Nigeria. Ibadan: The International Institute of Tropical Agriculture.

Israel, G. D. (1992). Sampling :The Evidence from Extension Program Impact. Gainesville, FL: University of Florida.

ISSER (2005). The State of Ghanaian Economy in 2004. Institute of Statistical, Social and Economic Research, University of Ghana Legon, Accra. p. 27.

Kumi, J.A. (2003). Factors Affecting Attitudes of Cocoa Farmers Towards Replanting of Cocoa in the Kwaebibirem District of the Eastern Region, Ghana. Unpublished Doctoral Thesis. Department of

Agricultural Economics and Extension. University of Cape Coast. Cape Coast, Ghana.

La-Anyane, S. (1985). Economics of Agricultural Development in Tropical Africa. London: John Wiley.

Lees, R. & Jackson, R.B. (1973). Sugar Confectionery and Chocolate Manufacturer. Aylesbury: Leonard Hill Books.

Lunning, H. A. (1999). Effectiveness and Efficiency of Agricultural Extension. Department of Geography of Developing Countries, Faculty of Geography, Utrecht University, Utreach, pp.1-10.

McGregor, A. (1981). Evaluation of Five Systemic Fungicides for Control of *Phytophthora* Pod Rot of Cocoa. 8th International Cocoa Research Conference Proceedings, Cartagena, Colombia, pp 295-297.

Miller, L. (2005). Understanding Relationship and Associational Research. The Informant 23 (2) Pennsylvania, USA: AIAEE.

MoFA (2003). Agricultural Extension Policy (Revised). Accra: Directorate of Agricultural Extension Services, MoFA.

Mohr, L. B. (1995). Impact Analysis for Program Evaluation, (2nd ed.).Thousand Oaks, CA.: Sage Publications.

Mosley, P. & Hulme, D. (1998). Micro Enterprise Finance: Is there a Conflict between Growth and Poverty Alleviation? World Development. 26 (5)

Nelson, N. (1981). African Women in the Development Landscape. London: Case and Company Ltd.

Neuman, W. L. (2003). Social Research Method: Qualitative and Quantitative Approaches. (5th ed). New York: Pearson Education Inc.

Omoto, W. (2004). Draft Proposal on Impact Assessment of Urban Agriculture Research and Development in Nairobi. Department of Research Development, Nairobi, Kenya.

Pallant, J. (2001). SPSS Survival Manual: A Step by Step Guide to Data Analysis using SPSS for Windows (Version 10). Australia: Allen & Unwin. p.136.

Pidwirny, M. J. (2002). Pesticide Use and Abuse: Land Use and Environmental Change in the Thompson-Okanagan. Royal British Museum.

PRMPR & SDV (2003). A User's Guide to Poverty and Social Impact Analysis. Washington, D.C.: The International Bank for Reconstruction and Development/The World Bank.

Rogers, E. M. (1983). Diffusion of Innovation. (3rd ed). , New York: The Free Press, A Division of Macmillan Publishing Co Inc.

Scoones, I. (1998). Sustainable Rural Livelihoods: A Framework for Analysis. Working Paper 72, Sustainable Livelihoods Programme, IDS, Sussex.

Stevens, J. (1996). Applied Multivariate Statistics for the Social Sciences (3rd ed.). New Jeysey: Mahway; Lawrence Erlbaum, p. 72.

Swanson, B.E. (1998). Improving Agricultural Extension. A Reference Manual: Strengthening Research-Extension-Farmer Linkages. Edited Burton E. Swanson, Robert P. Bentz & Andrew J. Sofranko. Rome: FAO.

Tabachnick, B. G. and Fidell, L. S. (1996). Using Multivariate Statistics (3rd ed.).New York: HarperCollins, p.132.

Takrama, K (2006). Production of Ghana Premium Cocoa: Primary Processing Operations. CRIG Newsletter, 2. (1). Cocoa Research Institute of Ghana. Tafo, pp.1, 6.

Van den Ban, A.W. & Hawkins, H.S. (1996). Agricultural Extension (2 ed). London: Blackwell Science Ltd.

Woodhouse, P., Howlett, D., Bond, R. & Rigby, D. (2000a). Stakeholder Analysis and Local Identification of Indicators of the Success and Sustainability of Farming Based Livelihood Systems. Working Paper 5. DfID Project R7076CA. Retrieved on March 15, 2005 at WWW http://les.man.ac.uk/ses/research/CAFRE/indicators/wpaper5.htm.

Woodhouse, P., Howlett, D., & Rigby, D. (2000b). Sustainability Indicators for Natural Resource Management & Policy: A framework for Research on Sustainability Indicators for Agriculture and Rural Livelihoods.Working Paper 2. Department for International Development Research Project No. R7076CA World Bank.WWW http://les.man.ac.uk/ses/research/CAFRE/indicators/wpaper2.htm.

APPENDICES

Appendix 1

Davis Convention for Describing Magnitude of Correlation Coefficients

	Magnitude of Correlation Coefficients (r)	Description
1	1.0	Perfect
2	0.70 – 0.99	Very High
3	0.50 – 0.69	Substantial
4	0.30 – 0.49	Moderate
5	0.10 – 0.29	Low
6	0.01 – 0.09	Negligible

Source: Davis, J.A (1971). Elementary Survey Analysis. Englewood, NJ: Prentice-Hall.

Appendix 2

STRUCTURED INTERVIEW SCHEDULE FOR COCOA FARMERS

COCOA FARMERS' PERCEIVED IMPACT OF THE COCOA HIGH TECHNOLOGY PROGRAMME ON THEIR LIVELIHOODS IN THE EASTERN REGION OF GHANA

Context of the Exercise

The main purpose of this study is to examine how you perceive the effectiveness of the 'Cocoa High-Technology' programme and how the programme has impacted your livelihood.

It is anticipated that the results would be useful in assisting top management of the Ministry of Food and Agriculture (MOFA), the Council for Scientific and Industrial Research (CSIR) and the Ghana Cocoa Board (COCOBOD) to make decisions to improve the programme.

Please Note:

The information given would be treated as confidential and would not be revealed to any body or institution therefore be candid in expressing your opinions and suggestions as much as possible. Your anonymity is assured.

THANK YOU

PART I

Perceived Effectiveness of the Main Components of the Cocoa Hi-Tech Programme

1. Please indicate first whether you performed the **under listed** activities on your farm by ticking [√] **YES** or **NO**.

   If your answer is **YES**, please rate how effective each activity has contributed to increasing your yields and/or income by using the following ratings.

5 =Very Effective [VE]

4= Effective [E]

3= Moderately Effective [ME]

2=Ineffective [IE]

1= Very Ineffective [VI]

Please put a tick [√] where appropriate

	Programme Component	**Activity**		**Ratings**				
		Yes	**No**	**5 VE**	**4 E**	**3 ME**	**2 IE**	**1 VI**
A	**Cultural Maintenance.**							
i	Weeding of the cocoa farm regularly							
ii	Removal of Basal Chupons, Overhead Canopies, and Mistletoes							
iii	Removal of dead husks (Pod and Cherelles-young cocoa pods)							
iv	Removal of all Cola, Ceiba (onyina) and Oil Palm trees.							

v	Leaving of 8 trees per acre of the farm.							
vi	Digging of trenches (gutters) in the farm for drainage							
B	**Application of fertiliser**	**Yes**	**No**	**5**	**4**	**3**	**2**	**1**
i	Application the fertiliser							
ii	Ring Application Method							
iii	Broadcasting Method							
iv	Application of the fertiliser at the beginning of the rainy seasons							
C	**Application of fungicides to control the Black pod disease**	**Yes**	**No**	**5**	**4**	**3**	**2**	**1**
i	Spraying of fungicides							
ii	Application rate of 6 sachets of fungicides per acre							
iii	Use of Knapsack sprayer for spraying							
D	**Application of insecticides to control Capsids**	**Yes**	**No**	**5**	**4**	**3**	**2**	**1**
i	Spraying of Confidor 200 SL							
ii	Spraying 2 tankfulls of mixture per acre(60 mls/acrea)							
iii	Use of a motolised mist blower							
E	**Harvesting , fermenting and drying**	**Yes**	**No**	**5**	**4**	**3**	**2**	**1**
i	Harvesting of pods every 3-4 weeks once the pods begins to ripe							

ii	Fermentation for 6-7 days							
iii	Dying of cocoa beans in sun							
	Any other activities (Specify) and Rate							
i								
ii								
iii								

PART II

Perceived Impact of The Cocoa Hi-Tech Programme on Farmers' Livelihood

1. Please indicate first whether or not the following underlisted aspects of your life have improved as a result of the Cocoa Hi-Tech programme by ticking **Yes or No.** If **Yes** please indicate the **extent** at which the Cocoa Hi-Tech programme has improved those various aspects of your livelihood by using the following ratings.

5=Very High [VH]

4=High [H]

3=Moderately High [MH]

2=Low [L]

1=Very Low [VL]

Please put a tick [√] where appropriate

	Livelihood Asset			**Ratings**				
		Yes	**No**	**5 VH**	**4 H**	**3 MH**	**2 L**	**1 VL**
A	**Natural Capital (the programme has resulted in**							
i	Increase in Yield							

ii	**Increase in Productivity (yield per unit area)**							
iii	**Increase Productivity (yield per unit cost of inputs)**							
iv	**Better quality of beans**							
B	**Physical capital**	**Yes**	**No**	**5**	**4**	**3**	**2**	**1**
i	Ownership of Sprayers (Knapsack sprayers, Mist blower)							
ii	Ownership of pruner.							
Iii	Ownership of Harvester							
iv	Access to vehicles (trucks, tractors etc.)							
v	Access to Sprayers (Knapsack sprayers and Mist blower							
vi	Access to prunner							
vii	Access to Harvester							
C	**Financial capital**	**Yes**	**No**	**5**	**4**	**3**	**2**	**1**
i	Increase in income levels							
ii	Increase in saving levels							
iii	Decrease in debt levels							
iv	Access to credit facility							
D	**Human capital**	**Yes**	**No**	**5**	**4**	**3**	**2**	**1**
i	Access to labour -skilled							
ii	Access to labour- unskilled							
iii	Access to public extension services (AEAs)							
iv	Access to private extension services (eg NGOs, input dealers)							

E	Social capital	Yes	No	5	4	3	2	1
i	Membership to association or farmer group							
ii	Support from association/farmer group							
iii	Ability to feed family members							
iv	Support to other family members							
v	Support of friends							
vi	Ability to pay school fees.							
vii	Other Socio obligation (pay of funeral dues, basic rate							
	Any other (specify and rate)							

2. **a**. What is/ are the **major problem(s)** that you encountered in the implementation the of Cocoa Hi-Tech Programme?

---

b. What do you think is/are the major **strength(s) of** the cocoa hi-tech programme?

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c. What do you think should be done **to solve the problems** of the cocoa hi-tech programme you encountered?

PART III

Demographic and Farm related Characteristics of Cocoa Farmers

1. a. District ----------

   b) Village/Town Name----------

2. Sex:

   a) Male [ ] b) Female [ ]

3. Please indicate your age at your last birthday (in years) ----------

4. Kindly indicate your highest educational qualification. Please tick [√]

   a. No formal schooling/education [ ]

   b. Primary Education [ ]

   c. Middle School Leaving Certificate [ ]

   d Senior Secondary School Certificate [ ]

   e. General Certificate of Education [ ]

   f. Tertiary [ ]

   g. Others (specify) ----------

3. How long have you been working as a cocoa farmer? ----------years.

4. Please indicate the size of your family (**household size**) ----------

5. a. How many cocoa farms do you have? ----------

   c. Please indicate the size of each farm

Farm Number	**Farm size(in acres)**
1	
2	
3	
4	
Total	

   b. What is the age of the cocoa farm that you applied the programme?

   --------years.

6. When did you first start using the cocoa hi-tech programme? Please tick [√] a. 2003/2004 [ ] b .2004/2005 [ ]

7. Please indicate the size of your farm that you applied the high-tech programme

Cocoa season	**Farm size(in acres)**
2003/2004	
2004/2005	
2005/2006	

8 Please indicate your yield in **kilos or bags**

Cocoa season	**Yield (Kilos)**	**Yield(bags)**
2002/2003		
2003/2004		
2004/2005		
2005		

9. Do you belong to any farmer organization/association?

a. Yes [ ] b. No [ ]

if yes , Name of organization .....

Date you joined the organization (month.....year.....)

Thank You Very Much.