KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI, GHANA

# The Cocoa Certification Program and Its Effect on Sustainable Cocoa Production in Ghana: A Case Study in Upper Denkyira West District

By

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# DECLARATION

I, Samuel Addae-Boadu, do hereby declare that this submission is my own work towards the M.Sc. (Environmental Science) and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.



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## ABSTRACT

The impact of voluntary standards and certification schemes on the sustainability of cocoa production of Ghana was investigated in the Upper Denkyira West District (UDW) from August 2012 to March 2014. Three schemes including Utz Certified, Rainforest Alliance (RA) Certified and Conventional systems of production was done from five communities in the district. Soil chemical analyses of 15 different farms were used for the study under each of the production system and percent shade trees cover and profitability estimate per acre were determined. Formal socio-economic sample surveys of 50 respondents under each production systems were used to study farmers' perceptions on voluntary standard and certifications schemes. The C and K were significant ($P<0.001$) higher in RA (2.984% and 0.624cmol$^+$/kg) than Utz (2.218% and 0.472 cmol$^+$/kg) than conventional farms (0.997% and 0.137 cmol$^+$/kg) respectively and Organic Matter significant ($P<0.001$) higher in Utz Certified and RA Certified than conventional (3.474%, 3.444% and 1.085%) respectively. The P was significant ($P<0.005$) higher in Utz (8.703 mg/kg and RA of 8.220 mg/kg) than the conventional (2.543 mg/kg). However, for soil pH and N, there were no significant differences among Utz Certified, RA Certified and conventional means. On perception indexes of cocoa sustainability, the overall score for Utz Certified and RA Certified were higher than their conventional counterparts with respect to buffer zones, records on the quantity of agrochemical and active ingredient of herbicide used. All systems of production recorded below the 40% shade tree cover on the cocoa farm per acre however differ in control plans by farmers to increase shade trees on the farm. However, the active ingredient of insecticides and fungicide used were within the approved lists of pesticides by Ghana Cocoa Board. Economic indicators (B/C Ratio, NPV and IRR) estimated show that cocoa production in general is profitable at a 24% discount rate. The study therefore established that Utz Certified and RA Certified farms were sustainably higher than the conventional farms in respect of cocoa production in Ghana.

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| | | |
|---|---|---|
| ANOVA | - | Analysis of variance |
| ASI | - | Anti-Slavery International |
| BCR | - | Benefit Cost Ratio |
| CAOBISCO | - | Association of Chocolate, Biscuit and Confectionery Industries of Europe |
| CMC | - | Cocoa Marketing Company |
| CODAPEC | - | National Cocoa Diseases and Pests Control Program |
| CPB | - | Cocoa Pod Borer |
| CRIG | - | Cocoa Research Institute, Ghana |
| CSAE | - | Centre for the Studies of African Economies |
| CSCE | - | New York Coffee, Sugar and Cocoa Exchange |
| CSSVD | - | Cocoa Swollen Shoot Virus Disease |
| EU | - | European Union |
| FLO | - | Fair-trade Labelling Organization International |
| FLO-CERT | - | Fair-trade Labelling Organization International Certification |
| FSC | - | Forest Stewardship Council |
| GDP | - | Gross Domestic Product |
| GSS | - | Ghana Statistical Service |
| ICCO | - | International Cocoa Organization |
| IFOAM | - | International Federation of Organic Agriculture Movement |
| ILO | - | International Labor Organization |
| IITA | - | International Institute of Tropical Agriculture |
| IOAS | - | International Organic Accreditation Services |

| | | |
|---|---|---|
| IPM | - | Integrated Pest Management |
| IRR | - | Internal Rate of Returns |
| LBCs | - | Licensed Buying Companies |
| LIFFE | - | London International Finance Future Exchange |
| MSC | - | Marine Stewardship Council |
| MT | - | Metric Tons |
| NGO | - | Non Governmental Organization |
| NPK | - | Nitrogen, Phosphorus, Potassium |
| NPV | - | Net Present Value |
| OM | - | Organic Matter |
| OC | - | Organic Carbon |
| OECD | - | Organization for Economic Co-operation Development of United Nations |
| PBC | - | Produced Buying Company |
| PPE | - | Personal Protective Equipment |
| QCC | - | Quality Control Company |
| RA | - | Rainforest Alliance Certified |
| SAI | - | Social Accountability International |
| SAN-RA | - | Rainforest Alliance Sustainable Agriculture Network |
| RCBD | - | Randomized Complete Block Design |
| RSPO | - | Roundtable on Sustainable Palm Oil |
| RTRS | - | Round Table on Responsible Soy |
| SE | - | Somatic Embryogenesis |
| UCC | - | University of Cape Coast |

| | | |
|---|---|---|
| UDW | - | Upper Denkyira West |
| Utz Certified | - | "Utz", means "good" in the Mayan language Quiché in Guatemala |
| VSIs | - | Voluntary Sustainability Initiatives |
| WACRI | - | West African Cocoa Research Institute |
| WHO | - | World Health Organization |

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# CHAPTER ONE

# INTRODUCTION

## 1.1 Background

Initiatives for social responsibility are originating in different sectors and corporations, and relations between market, state and civil society are changing (Cashore *et al*., 2007; Klooster, 2010). In production, individual producers as well as whole supply chain are addressed as responsible for environmental impact of production (Carter and Carter, 1998; Vermeulen and Seuring, 2009). Initiatives to create more sustainability therefore have an increasing focus on the supply chains, which can be define to encompassing all activities associated with the flow and transformation of goods from raw material stage, through to the end user, as well as the associated information flow (Seuring and Muller, 2008).

The supply chains of multinational companies and retailers have become ever-more complex, with raw materials and other product inputs being sourced from producers in every corner of the globe. At the same time, concerns about climate change, natural resource scarcity, and labor practices have made sustainability and corporate responsibility the watchwords of the day for many firms. To address the lack of innovation, low returns and perceived lack of production sustainability, voluntary standards and certification systems have emerged as a promising means for addressing sustainability and corporate responsibility in Ghana's cocoa sector in complex global marketplace.

Certification systems typically evaluate and audit – according to environmental and/or social sustainability standards - the processes or methods by which products are produced. Sustainable certification initiatives create incentives for farms and firms to improve their environmental and socioeconomic performance (Giovannucci and Ponte, 2005; Rice and Ward, 1996). In theory, certification enables the consumer to differentiate between goods and services based on their environmental and social attributes. This improved information facilitates price premiums for certified products, and these premiums, in turn, create financial incentives for farms and firms to meet certification standards. This mechanism provides the platform to comply with sustainable production technique, which was clearly outlined in The UN's Rio Earth Summit in 1992. The summit recognized standards as a principal instrument to promote sustainability by improving the livelihoods of farmers, by limiting environmentally damaging practices, and by offering new opportunities for product marketing.

**1.2 Problem statement**

The premium price paid for the certified cocoa beans has been the singly source of motivation for farmers migration into certification scheme. However it is not known how, in practical terms, farmers' practices differ from the conventional ways of producing cocoa and the approved ones under the certification programmes. It is also not clear how the new practices will impact on the sustainable production of cocoa in the long term.

Major nutrients for plant growth to support and sustain cocoa farms are not adequate. This is due to rapid organic matter decomposition, erosive nature of the rainfall and limited amount of weatherable minerals in the soil. Banned agrochemicals are still being sold in this country. These come in through porous borders between neighboring countries and Ghana. Farmers patronize these chemicals because they are cheaper than the approved ones. Field observations have shown from different parts of Ghana that a basic practice of some farmers over the years has been the mixing of several different pesticides which are sprayed on cocoa farms as a single dose pesticide expected to work "magic" on all insect pests/diseases associated with cocoa. A pertinent problem of such a practice is not only creating a mixture of unknown composition but more importantly having serious environmental implication both on the farmer, environment, cocoa tree and bean quality.

The social and economic welfare of farmers, farm workers and their communities depends upon farming. Health and safety are also important concerns for those involved in farming operations. Good practices include: adherence to safe work procedures, wearing of personal protective equipment (hat, face visors, overalls, boots etc), avoid using your mouth to clean nozzles, avoid using faulty sprayers and purchase of only approved pesticides for use on cocoa.

The cocoa industry has profited from the utilization of child labour in West Africa. While the number of forced child laborers may be disputed, children are undoubtedly involved in hazardous activities and subjected to mistreatment. Children typically perform the same arduous tasks and work the same hours as adults, but receive less pay. Tasks include transporting heavy loads, pesticide and fertilizer application, and the use of machetes.

Increased demand for agricultural commodities globally, especially cocoa beans coupled with the attractive prices offered have resulted in widespread promotion of cocoa cultivation by the government of Ghana to benefit from this commodity boom. The unbridled and unsustainable growth of agriculture in recent years has encouraged rampant deforestation and careless use of agrochemicals. Today, agriculture is the number one cause of forest destruction and species loss worldwide. According to Parrish *et al*., (1998), biological diversity is eroding due to the increasing pace at which forest environments are being converted into agricultural lands; the isolation and scarcity of protected areas and; the perpetual rise of the global population. Human disturbance on forested ecosystems is posing a serious threat to local biodiversity (Dobson *et al.*, 1997). In most areas of the world tropical deforestation has been attributed to timber extraction and agricultural expansion (Brown and Pearce, 1994; Kaimowitz and Angelsen, 1997; Donald, 2004). The highest rate of deforestation in Africa has been reported to have occurred in West Africa with the most rapid forest clearance of between 1.3% and 1.5% occurring in countries like Ghana (WRI, 1994; FAO, 1997).

Ghana's cocoa production is characterized by small-scale farming with an average productive cocoa area per household of approximately 2 hectares (Barrientos *et al*., 2008). The average yield per hectare is 450 kg (MMYE, 2008), which is low compared to on-station research trials. This situation implies that, allowing for additional income from food production and from other sources, most cocoa farmers do not earn a decent income.

**1.3 Objectives of the study**

The primary objective of the study is to evaluate the state of knowledge about the impacts of voluntary standards and certification schemes on the sustainability of cocoa production in Upper Denkyira West District of Ghana. The study specifically seeks:

a. To determine the levels of soil chemical properties (soil pH, organic carbon, soil organic matter, total nitrogen, available phosphorus and exchangeable potassium) between systems of production.
b. To verify the extent of shade trees percent cover and management control plans on cocoa farms.
c. To determine profitability estimates between Utz Certified, Rainforest Alliance Certified and Conventional systems of production.
d. To evaluate the perception of farmers on impact of voluntary standards and certification schemes on sustainability of cocoa production.

### 1.4 Justification of the study

Cocoa prices at the London and New York commodity auctions rose to record levels in mid 2010, reflecting the growing imbalance between supply and demand. Meanwhile, most smallholders have little bargaining power or influence on farm gate pricing mechanisms due to weak producer-market linkages and limited access to financial and capacity development services. They find little incentive to increase productivity, improve produce quality or adopt sustainable production methods. Investment in public structures such as research institutes, extension services and marketing boards is woefully inadequate in most producing countries. Consequently, producers lack proper facilities, know-how on good agricultural practices, and inputs such as planting material and new technologies. Crop loss due to pest and disease damage adds to their misery, and these smallholders and workers are trapped in a vicious circle of unsustainable production and poverty. Consequences of this unfortunate state of affair are felt throughout the entire cocoa value chain.

The reputation of chocolate and confectionary companies is at risk due to the consumers' increasing concerns about social, environmental and economic issues in the cocoa chain. Cocoa is in fact, ideally suited for sustainable production and social change. The major players in the market are just a handful of transnational companies. They are well placed to act as major drivers of change and bring about a more sustainable cocoa sector. The cocoa industry invests vast sums of money at only one end of the chain: the consumers, and on one topic: branding. The industry has grossly underestimated the situation at the other end of the chain: the cocoa bean producers. Nevertheless, encouraging developments are taking place, producers, governments, industry and consumers increasingly recognize the importance of sustainable cocoa production. In the

Netherlands, all the stakeholders in the chocolate sector signed an agreement, in March 2010, to source only sustainably produced cocoa for the Dutch market.

The demand for cocoa has grown steadily but, at present, the producing countries are unable to fulfill this demand. Over the past few years, the demand has regularly exceeded cocoa bean production. In fact, the quantity of cocoa processed has exceeded production resulting in declining cocoa stock and severe cocoa hedging (ICCO, 2010b). Further growth of the demand to meet the increasing chocolate consumption in emerging markets will intensify the pressure on the cocoa stocks and raise world cocoa prices to all-time high.

A close look at the two most important cocoa producing countries reveals declining production since the 2005/06 season, 15% in the Ivory Coast and 13% in Ghana (ICCO, 2010a). The industry therefore attempt to expand cocoa production in Asia, e.g. Cargill and Mars in Vietnam, in collaboration with the Dutch government, and Kraft in India. Increasing the cocoa acreage in this manner can inevitably lead to changes in the use of land use with cocoa competing with other agricultural crops or with nature, resulting in deforestation. It is important to note that this expansion to less traditional cocoa producing areas in Asia has not balanced demand and supply yet.

**1.5 Organization of Study**

The study is organized into six chapters. Chapter one provides the introduction, problem statement, objectives and justification of the study. Chapter Two gives an overview of literature relevant to the study. Chapter Three outlines the methodology employed to achieve the objectives of the study. In particular, it describes the study area and the sampling techniques adopted for the data collection. In Chapter four and five, the descriptive and empirical results are provided and conclusions from the study in Chapter six.

# CHAPTER TWO

# LITERATURE REVIEW

This chapter presents literature on studies related to the cocoa industry, cocoa production and technical efficiency analysis. It begins with origin and domestication, cocoa industry in Ghana, its importance, trade, consumptions, prospects, market overview and constraints. The concept of sustainable trade models and the certification systems for agriculture were also reviewed. It concludes with economic and policy rational for voluntary standards and sustainability problems in the cocoa industry.

## 2.1 Origin and domestication

The cacao tree, *Theobroma cacao* L., a diploid fruit tree species (2n = 20) is the source of dried cocoa beans used as the main raw material in the manufacture of chocolate, confectioneries and some cosmetics product. Although native to the humid tropical regions of the northern parts of South America and the northern parts of Central America (Bartley, 2005; Cheesman, 1944; Cuatrecasas, 1964; Motamayor *et al.*, 2008), the largest cultivation of cacao, an under-storey forest tree species takes place in West and Central Africa. Originally designated a member of the Sterculiaceae family (Purseglove, 1974), *Theobroma cacao* was recently re-classified into the Malvaceae plant family (Alverson *et al*., 1999). Since its first introduction in the early 19$^{th}$ century by the Portuguese and the Spaniards, the West and Central African region has become the largest producer accounting for some 70% of the world's cocoa output of more than 3.632 million metric tons (ICCO, 2010b). The main producing countries are Cote d'Ivoire (43 % of global production), Ghana (14 %), Nigeria (6 %) and Cameroon (5 %) followed by Togo, Gabon, Sao Tome, Equatorial Guniea, Sierra Leone, Congo and Liberia. The major market for cocoa beans include The Netherlands, United States of America, United Kingdom, France, Germany, Spain, Italy, Japan, China and India.

Traditionally, cocoa types cultivated are subdivided into three major '*geneti*c' groups: Forastero, Criollo (domesticated by the Amerindians in Central America), and Trinitario (hybrids between Forastero and Criollo, originating from Trinidad). While the Forastero trees are vigorous and more resistant to diseases, the Criollo trees are poor yielding and highly susceptible, although Criollo trees produce high premium quality beans with aromatic flavor. The Brazilian cocoa of the Amelonado type (Lower Amazon Forastero) was first introduced by the Portuguese into Principe around 1822, and reached Sao Tomé in the 1850s (Bartley, 2005). According to Nosti, quoted by Toxopeus (1964), it was from this collection that the Spaniards brought cocoa into the Island of Fernando Po (now Bioko), Equatorial Guinea in 1854. This collection in Fernando Po became the major source of cocoa introduced into mainland West Africa at several times by many persons including traders and migrant workers, agencies, missionaries among others. Available records showed that cocoa was introduced from Fernando Po by workers and traders like Squiss Ibaningo into Nigeria in 1874, Tetteh Quarshie into Ghana in 1878, and Cote d'Ivoire in 1879 (Edwin and Masters, 2005; N'Goran *et al.*, 1992; Opeke, 1969). Missionaries like the Basel missionaries, Royal Botanical Garden curators, and colonial administrations played significant roles in the introduction of cocoa types from different origins into the mainland West and Central Africa. These earlier introductions from Fernando Po formed the initial basis of cocoa grown in West Africa, and was referred to as the "West African Amelonado". During the late nineteenth century, the Colonial administration also introduced some red-podded cocoa materials from British West Indies into botanical gardens established in Aburi (Ghana) and Lagos (Nigeria) (Toxopeus, 1964). By 1910, Ghana, followed by Nigeria, had become one of the largest producing countries, thus making the West Africa sub-region an important growing area critical to the sustainability of the world's cocoa economy, a status it still maintains today.

### 2.2 Cocoa introduction history and genetic materials

The introduction of cocoa germplasm into island and mainland of Africa took place in response to two main waves of idea which naturally divided cocoa germplasm introduction into: 1. Exploratory Colonial Period (1822 – 1909), and, 2. Expansionary Experimental Pre and Post-Independence Period (1910 – 2010). During the first era which spanned early 19$^{th}$ to the end of the 19th century, cocoa seeds and plants were transported in barrels and shipments across the sea from the northern parts of Southern America and Central America to Africa. This was in response to the then imbibed and appreciated Aztec and Mayan culture of drinking '*chocolatl*', 'The Food of the Gods". The favorable similar tropical humid climatic conditions and abundant rainforest vegetation provided impetus for this transatlantic exploratory introduction which fortunately gave good results. The cultivation of cocoa was therefore successfully established along the rainforest belt of West and Central African countries with significant economic revolution for both producing countries and chocolate lovers especially in the North.

The first materials introduced were of Amazonian origin, unlike the Criollo varieties introduced to Asiatic and Oceanic regions. The germplasm established on the island of Principe in 1822 was the main basis of the cocoa industry on the island. Original planting was said to have consisted of 30 plants which most likely were taken from a single fruit (pod). Progenies of these trees provided seeds for planting other areas of the island (Bartley, 2005). By 1840, some quantities of cocoa were exported from the island. The variety which became known as Sao Tome "Creoulo" was self-compatible and homozygous and mostly related to the 'Comum' variety in Bahia, Brazil. This variety was taken both directly and indirectly through Fernando Po to other inland West and central African countries and became the basis of cocoa grown there. However, some other varieties were also introduced into Sao Tome from Ecuador, Trinidad and Venezuela in 1880. Consequently, the bulk of cocoa grown on farmers' plantation must have consisted of a mixture of these earlier varieties, but due to differential expression of self-incompatibility systems, the self compatible 'West African Amelonado' types must have dominated in the complex mixture of cocoa of diverse origin at the beginning of the 20th century.

During the second era which began at about the end of the 19th century and beginning of the 20th century, economic considerations for higher income and premium due to greater yields and higher bean and chocolate quality were the main reasons for germplasm introduction. Previously selected individuals (clones) rather than 'types' showing potentials for high yields, resistance or tolerance to pests, diseases and abiotic stress such as drought were introduced and engaged in cultivar development processes on experimental stations. During this last decade, however, the "People, Planet and Profit'' concept of *Sustainability* has become a significant factor in cacao germplasm introduction. This has bearing with the concept of "Preventive Breeding" where clones showing resistance to regionally important diseases of cocoa growing regions could be introduced through international intermediate quarantine centers. This was to ensure that in the unlikely case of disease spread, for example, witches broom from South America to Africa, there is present in the African germplasm collections, sources of resistance to cope with the new disease in order not to paralyze the local cocoa economy as is the case during any outbreak.

Since the first successful introduction of *'Amelonado*' cacao, Lower Amazon Forastero type into West Africa in the late 19th century, there has been series of additional germplasm introductions as reviewed by (Bartley, 2005; Aikpokpodion *et al.*, 2009). In Nigeria for instance, since formal selection and germplasm conservation programs around 1931 at the Nigerian Department of Agriculture in Moor Plantation, Ibadan there has been further germplasm introduction of Trinitario and Criollo selections from Trinidad and Ceylon (now Sri Lanka) (Jacobs *et al.*, 1971).

The British West African Colonial Administration established the West African Cocoa Research Institute (WACRI) in 1938 with headquarters in Tafo, Ghana and a mandate covering Gold Coast (Ghana), Sierra Leone, Nigeria and Liberia. Several materials belonging to Upper Amazon Forastero and Trinitario populations were introduced from Trinidad by WACRI in 1944 (Toxopeus, 1964). Efforts to increase genetic variability in the base population in response to outbreaks of disease epidemic had provided impetus for germplasm introduction into Africa. For instance, the outbreak of cocoa swollen shoot disease in the 1930s in Ghana, Togo, and Nigeria almost destroyed the cocoa industry due to insufficient genetic variability in the base population.

Consequently, new introductions were made in 1944 from Upper Amazon Forastero materials collected by F. J. Pound into the West African Cocoa Research Institute headquarters in Tafo, Ghana and Ibadan in Nigeria (Aikpokpodion *et al.*, 2009). Due to the precocity of these materials, they were widely distributed for replanting of cut out plantations and by late 1950s, some 11 selected Upper Amazon types have been used to produce second and third generations of Amazon known as "F3 Amazon" or "Mixed Amazon" distributed to farmers (Knight and Rogers, 1955). By 1961, some 60,000 ha in Ghana and an estimated 21 million seedlings had been distributed by the government of the Western Region to plant some 9,500 ha in Nigeria

(Aikpokpodion *et al.,* 2009). Several hybrid varieties involving crosses with local Amelonado, Trinitario, and some Criollo materials were also developed from these materials in Ghana (Lockwood and Gyamfi, 1979), Nigeria (Atanda and Jacobs, 1974) and Cote d'Ivoire (Besse, 1975; N'Goran *et al.*, 1992).

**2.3 The Ghanaian cocoa industry**

In Ghana, cocoa has played an important role in the economy of the country for over one century. Although the crop was believed to have been brought to the colonial Gold Coast - as Ghana was then known - from Fernando Po, an island in the Gulf of Guinea, off the coast of Gabon, in 1879 and from Sao Tome in 1886, records show that in 1891, only twelve years after it first arrived here, cocoa was being exported as a cash crop (Acquaah, 1999; Adjinah and Opoku, 2010). From the 1910/1911 season, Ghana became the leading cocoa producer in the world, a position it held until 1977, when it was overtaken by the Ivory Coast. The country went from being the number one cocoa producer to a period in the early 80s when, as a result of drought, bushfires, low producer prices, diseases and general economic malaise, Ghana fell to the twelfth position and produced less than 160,000 metric tons in the 1983/1984 season (Adjinah and Opoku, 2010).

Cocoa became attractive as a cash crop in Ghana because of the lower cost involved in its cultivation, compared to a popular crop like palm, as well as the favorable natural conditions that existed in the forest belts. Cocoa could be grown along with other crops and when soil conditions deteriorated the land could be left to the cocoa trees and other tracts tilled in the shifting-cultivation systems of farming (Acquaah, 1999). Because of the prominence that the crop had began to gain in the economy, even before World War II, government was seriously alarmed when the swollen shoot disease was discovered in 1936. In the process of combating this disease, a permanent research center was established at Tafo, in the Eastern Region, and product quality inspectorate, grading of beans, extension services and proper engagement of farmers in the growth of the crop were initiated (Acquaah, 1999). Since then government has continued to offer technical assistance, financial incentives and inputs like fertilizer and pesticides to cocoa farmers.

Over the last decade, as a result of government intervention, cocoa production has picked up, reaching a peak of 740 thousand metric tons in the 2005/2006 season (Aryeetey, 2007). Constituting 7.3% of the Gross Domestic Product of the country, it is second only to gold, which first overtook cocoa as the highest foreign exchange earner in 1992; a trend which still continues. Agriculture contributes about 35% of Ghana's Gross Domestic Product (GDP) and 60% of total employment. The Cocoa Industry is the single largest contributor to agricultural GDP (16.5 %). It is estimated that about 65% of the country's agricultural workforce work either directly or indirectly in the cocoa industry. In Ghana cocoa is grown on small farms owned by individuals and families in the forest zones of Ashanti, Brong Ahafo, Western, Eastern and Volta regions. Thus the livelihood of about two million farmers and their dependants, mostly in the rural areas, depend directly on cocoa (Opoku *et al.*, 2006).

### 2.4 Cocoa consumption

Cocoa consumption, as measured by grindings, increased by 2.5% from the previous season to 3,608,000 tons in 2006/2007. Despite a relative slowdown during that season, the cocoa market has been characterized over the last five years by a sustained demand for cocoa, rising by 3.8% per annum (based on a three-year moving average). It was supported by a strong demand for cocoa butter to rebuild stocks, as well as by rising chocolate consumption in emerging and newly-industrialized markets and changes in chocolate consumption behavior in mature markets towards higher cocoa content chocolate products.

At the regional level, developments were heterogeneous in 2006/2007, with grindings rising by around six per cent in Europe to 1,540,000 tons and to 514,000 tons in Africa. Meanwhile, they remained at almost the same level, at 699,000 tons in Asia and Oceania and declined by three per cent in the Americans to 853,000 tons. Processors located in Germany and Ghana contributed to almost half of the increase in world grindings, reflecting the installation of additional capacities in these countries. The Netherlands and the United States remained the major cocoa processing countries, each with grindings of more than 400,000 tons during the year. Major grinding in Asian countries is located in Malaysia, Indonesia and Singapore. In Indonesia per se, the real grinding progress is running under actual capacity. Its full capacity is calculated at around 350,000 tons a year.

An analysis concluded stating that Asia, Africa and Latin America account for 75% of the world's population, and yet consume just 20% of the world's cocoa. The potential in Asia is undoubtedly great. Currently, some three billion consumers account for just 8% of global consumption. As a result, even a slight increase in per capita consumption would equate to a large expansion in demand for cocoa. The countries with the highest growth potential must be China and India. Between them, the two countries have a combined population in excess of 2.2 billion - and this was expected to reach almost 2.5 billion by 2005. With economic growth rates approaching double figures, and a growing middle and upper class, higher incomes should lead to higher cocoa demand (Grey, 2000).

## 2.5 International trade and prices of cocoa

The major buyers of West African cocoas are in Western Europe, with the United States being a major buyer of South American and Asian cocoas. Cocoa is usually purchased from origin by international dealers (or traders) who subsequently sell it to final users (usually chocolate companies) as beans, or process it in their own plants and sell it to the final users as products (liquor, butter or powder). Chocolate companies and cocoa processors prefer to purchase through dealers because they bring the cocoa to a port close to the buyer. They often pass it through customs and the buyer can inspect the shipment and, if necessary, be compensated for any quality shortfall via arbitration, allowed for in the contracts. The prices at any time will be determined by the cocoa futures (or terminal) markets in London International Finance Futures Exchange (LIFFE) and New York (Coffee Sugar and Cocoa Exchange (CSCE) in response to the relative supply and demand balance at any given time (Lass, 1999).

Average international cocoa prices, as measured by the ICCO daily price, increased in 2006/2007 from the previous cocoa year by 19% to US$1,854 per ton. The large production deficit in the 2006/2007 cocoa season had been the main factor leading to this development in the market. Other bullish factors included the position in the futures markets of cocoa processors and chocolate manufacturers, having below-average forward fixed price coverage, and the weakening US dollar against other major currencies. The highest price level of the season was reached on 6 July 2007, when prices climbed to £1,140 on the London terminal market and US$2,144 in New York, their highest levels since 2003. However, the strong increase in recorded prices induced some nervousness among market participants and, at such relatively high prices, the markets were rendered vulnerable to profit taking in the second week of July, the cocoa futures markets witnessed a strong adjustment and, after a short-lived recovery, the markets again retreated until the fourth week of August.

The decline in prices was not attributed to particular bearish news on the fundamental cocoa supply and demand situation, but may have been related to concerns in financial markets over the US subprime mortgage market crisis. This may have prompted funds to reduce their investments in cocoa to cover stock market losses. However, the US subprime mortgage market crisis is likely to have acted only as a catalyst, hastening and exacerbating an expected downward correction at that time of the year in the cocoa market. Indeed, future cocoa prices had soared by more than 30% in London and by more than 40% in New York since the beginning of the 2006/2007 season until the beginning of July. From the August to the end of the 2006/2007 season, cocoa prices in future markets moved upwards, supported by concerns over the impact on production of the spread of black pod disease in some regions of Côte d'Ivoire, Ghana, and to a lesser extent, Nigeria.

## 2.6 Prospects of cocoa production

### 2.6.1 Economic importance in consuming countries

The importance of cocoa beans in the running of the multi-billion dollar annual earning chocolate and confectionery industries cannot be over-emphasized. The world grinding of cocoa beans in 2010/2011 season alone was estimated at 3.698 million metric tons (ICCO, 2010b). The world's exports amount to some US$5–6 billion/year and use of cocoa and cocoa butter in chocolate manufacturing, cosmetics, and other cocoa products drive approximately US$70 billion market and provides over 60,000 jobs in the US alone (Guiltinan, 2007). In an annual list of the top 100 global confectionery companies based on net sales in 2010 alone, the top ten chocolate confectionery companies accounted for at least US$ 67.59 billion. According to the

Association of chocolate, biscuit and confectionery industries of Europe (CAOBISCO) based in Brussels, some 1800 companies with 245,000 direct employees are involved in use of cocoa beans in manufacturing of their products. These industries account for more than 47.8 billion Euros annual turnover, a production of 14.1 million tons of products and some 4.1 billion Euros of exports, that is, 10% of the total value of food exports from the European Union (ISSER, 2008). The European chocolate and confectioneries industry which utilizes 50% of the world production of cocoa beans also consume some 30% of the European production of sugar, 35% skimmed milk powder at full EU price as well as a large share of the glucose, butter, wheat, eggs and dried fruit produced in the European Union (IMF, 2007).

### 2.6.2 Economic importance in West and Central African producing countries

Cocoa production is predominantly a smallholders' enterprise in Africa with several hundred-thousand families depending on this cash crop for their livelihood and significant foreign exchange earnings for producing countries (Rice and Greenberg, 2000; Motamayor *et al*., 2008). Revenue derived from sale and export of crops such as cocoa provides crucial support to livelihoods of farmers in developing countries in Africa and can be a sustainable means of helping millions of households live above poverty and hunger. In West and Central African countries, domestic economies revolve around subsistence agriculture, especially from the sale of products from cash crops such as cocoa. Even in countries such as Nigeria where most of budgetary revenues come from sale of crude oil, revenue from export of cocoa beans makes significant contribution to the nations' gross domestic product (GDP). The economic growth of many of the Least Developed Countries is closely linked with cocoa production, as well as other primary commodities. Many producer countries depend on cocoa exports for a large part of their foreign exchange earnings and government revenue.

In Cote d'Ivoire, the largest world producer with more than 1.3 million metric tons (MT), cocoa contributes more than 20% of government revenue. When international cocoa prices are low, governments have difficulties meeting debt service obligations and are unable to make much needed investments in basic health, education and infrastructure. In Cote d'Ivoire, more than three of some six million people are engaged in the cocoa sector are small scale farmers. Cocoa alone makes 35 *per cent* of total export estimated at US$10.25 billion in 2010 and 15 % of the 28.2 % agriculture's contribution to the GDP estimated at US$22.82 billion in 2010. Together with coffee, cocoa is referred to as the 'Green Gold" because of its immense contribution to the economy. It provides job for 60 % of working population and accounts for some 46 % of total export, more than a third of the nation's GDP.

In Ghana, the second largest producer with more than 700,000 MT, cocoa is the primary cash crop providing about one-third of all export revenue. With higher commodity prices, gold and cocoa were the two top export revenue earning sectors for Ghana where GDP was estimated at US$38.24 billion in 2010. Cocoa remains the mainstay of Ghana's economy accounting for 40 % of agricultural exports and 12 % of country's GDP. In 2007 for instance, cocoa contributed 35 % of Ghana's GDP and 60 % of employment in agriculture (Centre for the Studies of African Economies (CSAE), 2009). In spite of commencement of oil production in Ghana, agriculture, especially the cocoa sector would remain the key to rural transformation of the economy.

In Nigeria, cocoa provides means of livelihood to more than five million people. Although heavily dependent on oil, agriculture contributes significantly to the economy with about 70 % of the population engaged in agriculture. The cocoa sector accounts for some 27 % of the 41.48 % of GDP attributed to agriculture. Cocoa is the single largest non-oil export earning commodity for Nigeria. In comparison with other agricultural commodities, cocoa makes the largest non-oil contribution to the nation's economic development and accounted for 65% of total agricultural export in 2004 (Aikpokpodion, 2007).

In Cameroon, it is estimated that some four million people depend on cocoa and coffee for their livelihood. Most of the cocoa is produced primarily in central southern Cameroon by millions of small scale farmers. In Cameroon, cocoa cultivation is currently one of the major sources of revenues of rural households (1 to 2 millions of people) of the forest agro-ecological zones in the country (South and South-Western parts). Cocoa is grown in more than 200 000 farms and the total cocoa growing surface is estimated to be 400 000 hectares (Efombagn *et al.*, 2006). In other countries such as Togo, Sierra Leone, Liberia, Equatorial Guinea, Sao Tome and Principe, Gabon and Democratic Republic of Congo, cocoa production makes significant agricultural contribution to the GDP.

### 2.6.3 The place of cocoa in the food chain

While the soporific effect of cocoa drinks is widely known, recent research activities have unearthed additional more important health benefits which have enhanced further the attractiveness of cocoa products generally. There are three types of chocolate: dark, milk and white chocolates. Most of the benefits of chocolate consumption are associated with the dark brand. In the last decade, studies have shown that chocolate consumption can play an important role in the reduction of risks or delaying the development of cardiovascular diseases, cancer and other age-related diseases. It has also been linked positively to anti-carcinogenic activity in human cells, hypertension, diabetes and sexual weakness. It's newly found reputation as an aphrodisiac, stems from the ability of its sweet and fatty nature to simulate the hypothalamus, which induces pleasure sensation and affects the level of serotonin in the brain (Afoakwa, 2008).

Cocoa products contain flavonoids and amino acids, and these have been cited as the source of its beneficial effects, while carbohydrates, theobromine and lead have been mentioned as responsible for the negative effects. The flavonoids belong to a large and complex group of compounds called polyphenols and are found in plant products, mainly fruits and vegetables. The phenols in cocoa products have been associated with antioxidant properties, reduction in migraine, and protection of arteries from plaque formation and prevention of LDL formation two hours after dark chocolate and perceptible lowering of blood pressure. Some studies have also linked chocolate consumption to muscle recovery and delayed brain function decline (Reuters, 2007). Protein is broken down in the body to form twenty amino acids needed by the body. Eight of these are called essential, which means they are not made by the human body itself and must be supplied from outside. Fourteen of the twenty amino acids found in the body, including the eight essential ones, have been found in cocoa. In addition to building cells and repairing tissues, amino acids also have antioxidant properties, and they form antibodies to combat invading bacteria and viruses (Awuah, 2002).

While international standards are such that the pesticides used in the field can hardly find their way into chocolate, a number of documented negative effects have been associated with some of the natural and absorbed constituents of cocoa. Perhaps the major one is obesity. It is believed that the amounts of dark chocolate that needs to be consumed in order to experience the good benefits of the product could lead to obesity and its resultant negative effects. Although it is not supported by scientific studies, it is also believed that chocolate consumption can lead to acne. The heavy metal, lead, is known to maintain a high solubility in chocolate, and this may lead to lead poisoning (Rankin *et al.*, 2005). Chocolate is also known to be toxic to some animals like horses, dogs, parrots, cats and small rodents, because they are unable to metabolize the theobromine which is found in chocolate (Drolet *et al*., 1984; Blakemore and Shearer, 1943).

**2.7 Overview of Ghana's cocoa marketing system**

There are three main actor involved in the domestic supply chain of cocoa in Ghana: the farmers; the buying companies; and the Ghana Cocoa Board (formerly known as Cocoa Marketing Board, now simply referred to as COCOBOD) who oversees all production and marketing activities of the crop. The role of COCOBOD is central to understanding the functioning and the changes that occurred in the national cocoa supply chain over the period of reforms. Prior to 1992, COCOBOD was in full control of all operations along the domestic chain. These transactions were carried out by a variety of COCOBOD subsidiaries: the Produce Buying Company (PBC), which organized purchases throughout the cocoa growing regions; the Quality Control Company (QCC), responsible for the quality checks of cocoa beans at different collections points (in the villages, in depots, and in the ports, immediately before exports); and the Cocoa Marketing Company (CMC), in charge of all exports.

After the sector reforms that began in the early 1990s the COCOBOD retained a prominent role in the regulation of this market. Through the QCC it is responsible for ensuring that the overall quality of the beans is kept to the high standard for which Ghanaian cocoa is renown in the world markets. Through CMC it remains, to this day, the only authorized exporter of Ghanaian cocoa. Through the Producer Price Review Committee, COCOBOD also retained an important role in the price setting system: over the period of extended reforms, the only formal change in the process through which producer prices are set is that COCOBOD consults not only with representatives from the Finance Ministry, but also with farmers' representatives and various business groups involved in the sector. The producer price is still determined ahead of the main harvest season and remains fixed both throughout all growing regions and within the two crop seasons. In the structure and functioning of the internal market, COCOBOD remains responsible for issuing licenses to private purchasing companies (collectively known as Licensed Buying Companies, or LBCs) and is available to finance their operation, at the start of the season, by lending them money at slightly below market rates.

## 2.8 Constraints of cocoa production

The majority of cocoa farms in West Africa are small holdings owned by a large number of peasant farmers. For example, in Ghana, about 66% of farms are within the size range of 0-8 ha owned by 332,244 peasant farmers, with only 18.9% of the farms larger than 20 ha (Padi and Owusu, 2006). In Indonesia, the third biggest cocoa producers, smallholder portion contributes to ca. 80% of the national business, involving ca. 1.7 million farmer families.

Problem facing by cocoa producers frequently occurred in a long period and could only overcome by external assistance. Farmer in term of smallholder could only sustain for their food and simple live. The most problems facing by cocoa production sector consists of technical and non- technical problem covering production including low productivity, pest and disease, and quality. Trade barrier, phyto-sanitary and sustainability issues are also constrains for cocoa sector especially from the developing and under-developed countries.

### 2.8.1 Low Productivity

Productivity is one of the key for success in cocoa farming. This condition is a function of technology in terms of R & D, producer's skill and socio – economic, nature in terms of climate and soil, and external issue in terms of market situation, pricing and authority policy. Productivity is one of the most important economic factors affecting the cost of production per ton of cocoa beans. At higher productivity, the cost of production per t of cocoa will be lower and vice versa. In view of this, effort should be made to increase productivity to maximize profit making.

Referring to data from Cocoa Producer's Alliance (2008), average productivity in all main production area is still low standing below 1 ton / ha / year. The average national productivity in West African countries, Brazil and Indonesia, and Malaysia are 0.2-0.3, 0.5-0.6 and 0.8-1.0 tones/ha/year respectively. According to Yusof *et al.*, (2000), well-managed cocoa farms produced cocoa bean at average 2.0-4.6 tons/ha/year meanwhile the highest productivity recorded by Ashar and Lee (2004) is 5.0-6.8 ton/ha/year (Ashar and Lee 2004).

### 2.8.2 Plant material and propagation

Plant material is one of the key points to improved productivity and quality of cocoa bean. Plant material is a limiting factor in the development of cocoa in some countries especially those held by smallholders. Incorrect selection of plant material will cause a long term difficulties in cocoa farming and achievement of good productivity and good quality production. Cocoa plant material can be provided through two ways namely seedling and clonal methods. The latest has become important in cocoa farming due to its uniform cultivation and genetically vigor-performance.

Recently, cocoa cloning through somatic embryogenesis (SE) propagation seemed to be the choice in preparing cocoa plant material in a bulky quantity. Experiments conducted by Centre de Recherche Nestle Tours in France and planting in cocoa garden in Ecuador showed that the cocoa cultivation produces more robust canopy and higher production.

### 2.8.3 Pests and diseases

#### 2.8.3.1 Black pod rots

Black pod or *Phytophthora* pod rot has been the primary fungal disease affecting cocoa production worldwide since the 1920's. In 1979 a detailed study of the taxonomy of the species of *Phytophthora* affecting cocoa proposed three species, *P. palmivora*, *P. megakarya* and a third uncertain species, tentatively identified as *P. capsici*. *Phytophthora palmivora* has a world-wide distribution on cocoa, while *P. megakarya* is confined to several countries of West Africa and *P.capsici* to South America, Central America and the West Indies (Thorold, 1975). The major economic loss is from infection of the pod. Pods can be infected at any age, but most significant economic loss arises from infection during the two months prior to ripening. Pods infected at this stage can be a total loss because the fungus can easily pass from the pod husk to the seed-coat of the bean in a developing green pod. Production damage by this disease assumed at high level as high 450,000 metric tonnes a year.

Black pod is difficult to control. The mycelium has been found in varying amounts in rotting cocoa pods, and viable *Phytophthora* spores have been found to survive on heaps of pod husks for up to three months. Insects, particularly ants, have been found to be involved in the spread of *Phytophthora* in several places (Wardojo, 1992). Thus there is little advantage in early season control.

Chemical control of black pod by spraying with copper fungicide is a well-established control method. However, copper-based fungicides are not completely effective in wetter areas because the chemicals are often washed off by heavy rains and need to be repeated. Cultural techniques such as shade reduction, regular harvesting and frequent weed control may reduce infection, but some losses from black pod are almost inevitable if the area is subject to long periods of high humidity. Reduction of shade, regular weeding and pruning of cocoa trees coupled with frequent removal of epiphytes and chupons, will all reduce the humidity by improving air circulation (Wardojo, 1992).

Piles of pod husks can act as a source of inoculum though only for cocoa trees close to the husk piles. It may be a wise precaution to spray the husk piles with a recommended fungicide during routine rounds of spraying.



#### 2.8.3.2 Capsids

Capsids, also known as mirids (Heteroptera: Miridae), are the most economically important insect pests of cocoa in West Africa. In Ghana, cocoa mirids have been known as serious pests since 1908, reflecting the situation before the introduction of cocoa (Padi and Owusu, 2006). Capsids infestation spreads in most cocoa producing countries in West Africa, Latin America and Asia. Estimation of crop losses due to capsids is always complicated by the inadequacy of records and the complexity of losses from other causes such as fungal and viral diseases and drought. Crop losses in cocoa due to capsids and mealy bugs have been estimated at 25-30% per annum (Wills, 1962). In 1957, crop loss in Ghana attributed to capsid damage alone was estimated at 60,000 to 80,000 tons of dry cocoa (about 25%) (Stapley and Hammond, 1959). Yield loss may be as high as 75% in cocoa farms attacked by capsids and left unattended for a period of over three years (Anon, 1951). Recent studies indicate that about 25-30 % of the national cocoa acreage in Ghana has significant mirid damage, with an annual crop loss of about 100,000 tones (Padi and Owusu, 2006).

#### 2.8.3.3 Cocoa swollen shoot virus (CSSV)

One of the most important cocoa diseases in West Africa is the Cocoa Swollen Shoot Virus disease, caused by Cocoa Swollen Shoot Virus (CSSV) (Dongo and Orisajo, 2007). The disease has been a major factor in the decline of cocoa production in Ghana and Nigeria over the past several years (Thorold, 1975; Woods, 1987). The responsible pathogen, CSSV, spread from tree to tree by mealy bugs and over 8 species of mealy bugs are known to be capable of transmitting the virus (Padi, 1997). *Planococcoides njalensis* (Laing) and *Planococcus citri* are known to be the most important mealy bug vectors by virtue of their being the most abundant serious risk of causing early infections of the re-planted farms implicated with transmission of cocoa swollen shoot virus (CSSV). Cocoa swollen shoot virus viral attacks during different stages of its growth and development causing varying leaf pattern symptoms seen as a network of red bands along veins and chlorotic mosaic effects leading to early senescence and leaf shedding. Dzahini-Obiatey, *et al.*, (2006) reported that studies in Ghana showed the CSSV infections were apparent in 20 (53%) out of 38 farms and they pose a serious risk of causing early infections of the replanted farms.

### 2.8.3.4 Cocoa pod borer

Cocoa is the principal host of the cocoa pod borer (CPB, *Conopomorpha cramerella* Sn., Lepidoptera: Gracillariidae) in Sabah (Chong-Lay *et al*., 2006). It is one of the more recalcitrant cocoa pests, capable of causing great financial loss, estimated at 31% of the value of the crop on a plantation in 1994. Although damage can be contained through use of insecticides there is great concern that they are losing effectiveness over time, as well as risks to consumers and environment alike. According to Santoso *et al* (2004) the major insect pest threatening cocoa production in Indonesia, as well as in the rest of Southeast Asia, is cocoa pod borer. Damage caused by the CPB in South East Asia is suggested to be around 40,000 tons a year (Lim, 1992).

CPB larvae attack the economically important cocoa pod, which contains the beans used for chocolate production. Members of the same genus, *C. sinensis* (Bradley) and *C. litchiella*

(Bradley) attack litchi and longan fruits in Taiwan and China (Yao and Liu, 1990). The adult CPB is a mosquito-like, approximately 1-cm long moth. The female moth lays up to 200 eggs on the furrowed surface of the cocoa pod. After a few days, the eggs hatch, larvae emerge and burrow directly into the pod, eating the pulp tissue (mesoderm) and placenta, and disrupting the nutrient flow for developing beans. The pod dries up after the larva have fed on the pulp surrounding the beans, and the entry hole allows infections to rot the pod, which can cause the pod to turn yellow prematurely as well as cause the clumping of deformed beans. Approximately two weeks after hatching, the larvae leave the pod and pupate on the pod or leaves (Wardojo, 1992; Lim, 1992). Crop losses due to cocoa pod borer can be as high as 80%. So far, there has been no single cost-effective and environmentally safe way to control this pest. Residing inside the pod the larvae are out of reach of chemical sprays.

**2.9 The Growth of a new model for sustainable trade**

Increasing public concern for the quality, safety and methods of agro-food production have combined with increasingly globalized commodity chains to result in a greater demand for goods produced according to private standards. Among these are standards branded on their ability to promote sustainable development such as Organic, Fair Trade, Utz Certified, Rainforest Alliance Certified, etc. Virtually all of the major sustainability standards embody some combination of environmental, economic and social goals, though the degree to which they endeavor to achieve each of these sustainability objectives varies considerably.

Sustainability in commodities production and trade is influenced by varied factors including both public and private choices. At the public level, regulation and policy on environment, agriculture, trade, tax, investment, energy and climate change bear core relevance. At the private level, decisions about quality and safety standards, globalized supply chains, cost-driven procurement and differentiation all have profound impacts on sustainability in agro-food production and trade. While these approaches may operate with different assumptions and objectives, any discussion of sustainability in commodities in recent years has revolved around the issues of standards (Raynolds *et al.*, 2007; Giovannucci and Ponte, 2005). Beginning with Organic and Fair Trade standards and increasingly encompassing perspectives of trade associations and private firms, these standards have evolved beyond niche markets into mainstream distribution channels that are accessible to many consumers (Lewin *et al.*, 2004). As such, products certified to the most popular sustainable standards have begun to capture not only significant market share, but also significantly greater value than comparable agro-food commodities (Liu (ed.), 2008; Potts *et al.*, 2007).

## 2.10 The key standards and certification systems for agriculture

The first standard for agricultural commodities was started in the 1940s for organic agriculture. These standards became more systematic following the 1972 establishment of the International Federation of Organic Agriculture Movements (IFOAM), which served as a mechanism for communication among what were many separate initiatives. Since then, many other systems have emerged, following diverse pathways. Four important points stand out:

Firstly, the emphasis on environmental, social, and economic/business issues in the standards varies. Social and economic issues are important in Fair-trade. Economic and business issues are highlighted in the Roundtable on Sustainable Palm Oil (RSPO) and the Round Table on Responsible Soy (RTRS), as well as schemes such as Utz Certified. All standards pay attention in varying degrees to the environment, with some focused on health and safety issues (e.g., Global G.A.P.) and others more on conservation (e.g., the Rainforest Alliance Sustainable Agriculture Network, or SAN-RA) (Potts *et al.*, 2007).

Secondly, many schemes have business-to-business models, whereas others aim to influence consumer purchasing through on-product labels. Fair-trade, Utz Certified, and SAN-RA create partnerships between producers and consumers. IFOAM supports the development of national standards consistent with a set of general principles. Revenue models also vary. Initiatives such as IFOAM, Utz Certified, SAN-RA, and Fair-trade International receive a significant amount of revenue through grants, whereas Global G.A.P depends entirely on fees for membership and services (Potts *et al.*, 2010).

Thirdly, the geographic coverage and products covered also vary among schemes. Some of the more established schemes are found in many countries of the world. Some schemes, such as organic (which is a whole farm standard), cover almost all agricultural products, whereas others are focused on a single commodity or just a few commodities.

A fourth point, which is not visible, is that standards have been driven and refined over time by different combinations of stakeholders and institutional changes. EU policies were important influences for organic schemes and Global G.A.P (Tallontire *et al.*, 2011). Retailers have played key roles in the roundtables (e.g., RSPO and RTRS) as well as Global G.A.P and Utz Certified. Utz Certified grew from the efforts of a single Dutch coffee company to become an international multi-stakeholder standard. Global G.A.P. remains an industry standard with decision-making limited to supply chain actors. Many retailing firms of course also set and maintain their own standards - for example, TESCO's Natures' Choice and Carrefour's Filières Qualité. Nongovernmental organizations (NGOs) have been important to Fair-trade, SAN-RA, and the commodity roundtables.

Over time, there has been a trend to separate out standard-setting and certification responsibilities. For example, Fair-trade Labeling Organizations International (FLO) was established in 1997 and then split in 2003 into Fair-trade International - focusing on setting standards and supporting producers - and FLO-CERT, an independent company that inspects and certifies producer organizations and audits traders.

### 2.10.1 Rainforest Alliance / Sustainable Agriculture Network (SAN)

The Rainforest Alliance was founded in 1987 in response to the massive deforestation and extinction of many species in tropical rainforests throughout Central America in the 1980s. Its first programs, launched in 1989, focused on responsible forest management (SmartWood) and environmental education (Conservation Media Center, later the Neotropics Communications Center). The first agriculture standard (ECO-OK) for bananas came into being in 1990, followed by coffee (1995), citrus and cocoa (1997), which laid the groundwork for establishing the Conservation Agriculture Network (1998), now called the Sustainable Agriculture Network (SAN). SAN is a member-based organization consisting of seven Latin American NGOs, one Indian NGO, and Rainforest Alliance; it now operates as the standard developer and manager for Rainforest Alliance agricultural standards. SAN's mission is to improve environmental and social conditions in tropical agriculture through conservation certification. Products that are deemed compliant with SAN established standards can carry the Rainforest Alliance label. Rainforest Alliance's growth strategy has been closely linked with its ability to negotiate supply arrangements with major manufacturers such as Unilever, Mars Inc., Kraft, Chiquita, McDonalds, Costa, Gloria Jeans, and etc.

### 2.10.2 Utz Certified

"Utz", means "good" in the Mayan language Quiché in Guatemala. Utz Certified began as an initiative in 1997 under the Dutch Ahold Coffee Company, along with Guatemalan coffee producers, to create transparency along the supply chain and reward responsible coffee producers. At the time, there was a growing demand for assurance of responsibly grown coffee and Utz Certified recognized the need to provide roasters with the tools to do so. In 2002, Utz Certified became an independent organization and has since expanded to other commodities (cocoa, tea, palm oil) to create an open and transparent market for agricultural products, as well as sustainable supply chains. The original Utz Certified criteria were based on an expanded version of the EurepGAP criteria and, as such, placed a strong emphasis on responsible farm management. Another defining feature of the Utz Certified system has been its inclusion of requirements for traders to provide information on premiums paid for Utz certified products, which are then aggregated and made available as averages to producers as a means to promoting market transparency and liquidity in Utz Certified products.

### 2.11 Sustainable cocoa market growth and coverage

Actual market development for sustainable cocoa is relatively small to date. As of 2009, four voluntary sustainability initiatives (VSIs) were providing sustainable cocoa to the market: Fair-trade, Organic (IFOAM), Rainforest Alliance and Utz Certified. Both Fair-trade and Organic cocoa have been available since 2000, while Rainforest Alliance did not begin certifying cocoa until 2007. Utz Certified, which initially only focused on coffee certification, finalized its cocoa standard in 2009 and reported a small amount of certified cocoa volumes produced and sold for that year. As a result of the recent new entries into the sustainable cocoa sector, as well as the small market share to date, the sector as a whole is extremely dynamic and undergoing rapid change.

Over the past five years, sustainable cocoa sales have grown by 248 per cent and, at 46,896 metric tons, accounted for 1.2 per cent of global sales by the end of 2008. Organic cocoa sales, at 20,000 metric tons in 2009, have the largest market share among sustainability initiatives in the cocoa sector. Volumes for 2009 are up 14 per cent from 17,500 metric tons in 2008 (Liu, 2008). Fair-trade, the second largest supplier of sustainable cocoa has grown by 1,000 per cent since 2001. Between 2008 and 2009, Fair-trade sales grew from 7,306 metric tons to 13,000, or 78 per cent. Rainforest Alliance has also experienced rapid growth since its entry into the market in 2007, selling an estimated 8,500 metric tons of certified cocoa in 2009, up 27 per cent from 6,700 metric tons in 2008. Utz Certified reported selling 5,396 metric tons in 2009 (Utz Certified Annual Report, 2009).

Despite the growth of Fair-trade, Rainforest Alliance and Organic cocoa over the past several years, overall market share remains small, with total certified cocoa at approximately 1.2 percent of global sales by 2008 - Organic accounts for 0.8 per cent (0.7 per cent if accounting for double certification with Fair-trade); Fair-trade, 0.3 per cent; and Rainforest Alliance, 0.2 per cent of global market share. The distribution of sustainable cocoa production varies considerably depending on the initiative and provides a bird's eye view of where different initiatives are most active. Africa is the majority producer of sustainable cocoa, accounting for 51 per cent, or 76,450 metric tons. Latin America accounts for 48 per cent of sustainable cocoa sales, producing 72,521 metric tons. Asia and Oceania account for 0.5 per cent, producing 762 metric tons. Currently, four countries - Ghana, Ivory Coast, Dominican Republic and Peru - account for 3 per cent of sustainable cocoa, while these four countries account for 53 per cent of conventional cocoa production for export. The figures of sustainable production stand in contrast to the overall supply of conventional cocoa on the global market, of which 70 per cent is produced in Africa.

Both Rainforest Alliance and Organic cocoa have driven this trend with 76.2 per cent and 75.7 per cent, respectively, of their total supply provided by Latin America. Fair-trade represents the exception to this rule, being predominantly supplied by African producers. The trend for sourcing is likely to change, not only as the field for certified cocoa is fairly new, but also as Western African producers start to certify their production. Organic cocoa is the only sustainable cocoa with sourcing (4.9 per cent) from Asia.

### 2.12 The economic and policy rationale for voluntary standards

Standards-based sustainability initiatives are fundamentally instruments for monitoring and communicating the sustainability of products based on the production and processing methods applied along the supply chain. Where products are identified as complying with specific sustainability criteria, they provide a direct instrument for enabling the market to value them. To the extent that the market actually does place additional value on "sustainable products" as compared with "conventional products," standards can be said to play an explicit role in internalizing the social and environmental costs of production - itself a core principle of sustainable development. But the role of standards in promoting sustainable development extends beyond the mere promotion of "good practice". Indeed, the very fact that standards produce additional information about market activity that is relevant to economic decision-makers (e.g., information about production practices) - means that standards have the potential to improve overall social welfare by enabling more informed decision-making (e.g., more efficient markets).

By providing such information, standards have the potential to reduce or eliminate the presence of some market externalities by more accurately matching individual preferences in the marketplace. To the extent that negative externalities are a core cause of both market inefficiency and negative social and environmental outcomes, standards have the capacity to systemically improve overall social welfare and sustainable development through their communication and governance roles (Potts, 2002; Giovannucci and Ponte, 2005). Thus, while premiums for standards compliance are commonly cited as the most important economic achievements of such initiatives, the potential for premiums arguably pales in comparison to the more generic role of standards in improving transparency and information in the market (Potts, 2007).

In addition to helping promote economic efficiency, voluntary standards can leverage market forces to reach policy objectives. Such market-based policy promotes static and dynamic efficiency in the market place and is thus more effective than traditional "command and control" policy. The ability of sustainability standards to play an effective role in cost internalization, market efficiency, or efficient policy implementation fundamentally depends upon the degree to which such systems operate as effective communications tools. The implementation, monitoring and communication infrastructure which has developed around sustainability standards and initiatives represents a significant advancement over conventional manufacturer and retailer driven "on package" and advertising-based communication channels. The use of multi-stakeholder-developed criteria, available for public scrutiny and verified through independent third-party auditing, although not always a feature of such standards, has been positively elaborated, promoted and applied by many of the sustainability standards systems.

### 2.13 Process of standard setting, certification and accreditation

The process of actually designing a labeling and certification scheme usually starts with the designation or the establishment of a body that will carry responsibility for the development of that specific scheme. Key points in the process may include:

- Selection of products or services that will be covered by the scheme;
- Decision which stakeholders to include in the process and which to exclude;
- Designation or establishment of a standard setting body;
- Design of a procedure for the setting (and revision) of standards;

- Actual setting of standards;
- Choice of a system for assessment;
- Design of a procedure for application, inspection and certification;
- Designation or establishment of a certification body;
- Choice to use a logo or not;
- Decision about the need for accreditation of certification bodies.

The object of a labeling and certification scheme may include one or more products (or product groups), or a services. The targeted producers of labeling and certification schemes can be primary and secondary producers, traders, importers and exporters, and retailers. The targeted buyers may include consumers, but also corporate and public buyers.

During the standard setting process the definition takes place of the general principles underlying the scheme and the specific standards or criteria that have to be complied with by applicants and licensees (OECD, 1997). These standards are in fact a set of qualitative and/or quantitative technical requirements, and usually refer to a product or service as well as its production process. The present systems for the total assessment of the standards or criteria in a specific case can be roughly divided in "pass/fail" systems and "scoring" systems. The first type of system uses criteria in the form of bottom line values that all have to be met. The second type of system makes the award of the label dependent on a minimum total score that is based on the sum of individual scores for each criterion. A subtype of the scoring systems is the 'graded' system that allows for a more fine-tuned assessment. Mixed systems are also possible.

Once the standards for a specific scheme have been set, the scheme will be opened for applications. Suppliers of goods and services have then the choice to apply for participation in the scheme or not. In some cases however it may be doubted if participation is really on a voluntary basis. In the UK, for example, participation of growers in the Assured Produce scheme gives in fact the “licensee to supply” to the leading supermarket chains that have an enormous market power. The next step will be an assessment whether an application is in conformity with the general principles and criteria of the scheme, usually in combination with an on-site inspection of the production operation. If all principles and criteria are met, the label or certificate that symbolizes the scheme will be awarded to the applicant.

Most labeling and certification schemes provide for procedures to revise the standards and criteria in place. This is usually combined with the right to use the label or certificate for only a limited period of time. Once the validity date is exceeded, the licensee or holder of the certificate or label is no longer allowed to use the label and has to renew the application. Revision procedures make it possible to adapt standards and criteria to new insights and new developments, thus enabling the specific system to evolve over time.

In case of independent certification bodies, these may be subject to an accreditation procedure by which an authoritative body verifies that the certification body is operating at a uniform level of quality and competence by assessing the organization against certain standards. National accreditation bodies have been established in both the private and public sector in countries world-wide (Mallett, 2002). In many countries, there is one nationally recognized institution that serves as the government-sanctioned accreditation body. These bodies accredit the competence of certification organizations to issue certificates for a broad range of products and services, including certificates that relate to the environmental and social qualities of the product. In contrast to national accreditation bodies, several international accreditation systems have emerged in recent years that verify the competence of certification bodies to operate in specific sectors. They have their private origin in common and their concern for sustainability issues. Among the international accreditation systems that have been developed are (Mallett, 2002):

- International Organic Accreditation Service (IOAS), which accredits certifiers to the IFOAM basic standards on organic production and processing;
- Social Accountability International (SAI), which accredits certifiers to SA8000, a standard focusing on social practices in the workplace;
- Forest Stewardship Council (FSC), which accredits certifiers to the FSC principles and criteria for well-managed forests, and
- Marine Stewardship Council (MSC), which accredits certifiers to standards for well managed fisheries.

As a consequence of the multitude of accreditation systems, a certain certification body may have different accreditations based on general national accreditation systems as well as sector-specific ones.

## 2.14 Sustainability problems in the cocoa channel

Sustainability problems in the global cocoa channel are described according to the three dimensions of sustainability: social, economic and ecological sustainability.

### 2.14.1 Social sustainability

#### 2.14.1.1Child labor

There have been persistent signals about child labor in West Africa during the harvesting and the on-farm processes. However, not all work is considered harmful to or exploitative of children. In West Africa children have worked in agriculture traditionally as part of the family unit. Child labor is defined as work that prevents children from attending and participating effectively in school or is performed by children under hazardous conditions that place their healthy physical, intellectual, or moral development at risk (ILO, 1973). From recent research in four West-African countries (Cameroon, Côte d'Ivoire, Ghana, and Nigeria), the occurrence of the former was evident. Hundreds of children, often without family-ties to the farmer, are using machetes to clear the fields and applying pesticides, which are both considered hazardous (IITA, 2002).

From the information available now, it seems that large-scale plantations are a main locus of the malpractices. The alarming reports of children being kidnapped from their towns to work unpaid on distant plantations, has indeed been appointed to the large scale plantations in Western Africa (IITA, 2002). It is imaginable that corruption and bad institutional practice also play an important role. The International Labor Rights Fund has sued Nestle, Archer Daniels Midland, and Cargill in Federal District Court in Los Angeles for involvement in the trafficking, torture, and forced labor of children who cultivate and harvest cocoa beans that the companies import from Africa. They filed suit on behalf of a class of Malian children who were trafficked from Mali into the Ivory Coast and forced to work twelve to fourteen hours a day with no pay, little food and sleep, and frequent beatings. The three children acting as class representative plaintiffs are proceeding anonymously, as John Does, because of feared retaliation by the farm owners where they worked.

It also was filed in the wake of the chocolate industries missed the 1 July 2005 federal deadline to develop standards for monitoring and certifying African suppliers, an attempt to keep tabs on the labor practices of cocoa farming operations. The deadline is part of the Harkin-Engel protocol, which is described in more detail in Chapter 5.

#### 2.14.1.2 Health problems

Health problems occur due to exposure to pesticides. Absences of adequate knowledge, failure to wear protective clothing and lack of maintenance on pesticide application equipment are major causes of these health risks. Residues that are washed of the equipment too close near a drinking well sometimes pollute drinking water (Matthews *et al.*, 2003). These health risks are even more poignant, imagining children exposed to them.

### 2.14.2 Economic sustainability

Worldwide more than 20 million people depend directly on cocoa for their livelihood. An estimated one third of the world's cocoa crop is lost to pests and diseases every year. This can be devastating for farmers, which produce mainly small-scale. Another strain for farmers is the constant fluctuation of world market prices and it is often difficult for cocoa farmers to sustain in their livelihood. The often too low prices create a situation with economic problems that attracts ecological and social problems as well.

Another subject discussed in the Brundtland Report is the inequality between industrialized (Northern) and less developed (Southern) countries. One dimension of inequality is the fact that Northern countries have significantly more industries that add value to the basic commodities produced in developing countries. Where the African farmer can earn a few dollars for ten kilograms of cocoa beans, the Western producer earns the ten- to hundredfold when selling processed and manufactured chocolate.

Hence, producing countries mainly gain from the basic commodity, the beans. The question is, however, how much benefit this brings to the local community, seeing that liberalization reforms in the '90, stimulated by the World Bank, have made it possible for large multinationals to integrate vertically into the market, giving local exporters extreme difficulties to compete. And indeed, the rate of local exporters has dropped dramatically in African producing countries due to difficulties in obtaining capital and lack of experience in operating in an open market (ASI, 2004).

Where agricultural production in industrialized countries is highly subsidized and developed, farmers in developing countries are often not supported sufficiently. This often results, among others, in lack of knowledge on modern farming techniques, bad pesticide use and less income for the farmer. For example: The most severe problem faced by cocoa farmers is pest and disease control. At a global level, yield losses due to disease are estimated at about 30 per cent. In West Africa, it ranges from 10 to 80 per cent (10 to 30 per cent in Côte d'Ivoire, 30 to 50 per cent in Ghana and 50 to 80 per cent in Cameroon). Ghana's cocoa growers are unable to obtain adequate levels of necessary inputs. The Government removed its input subsidies about four years ago following the restructuring of the cocoa sector as suggested by the World Bank (ASI, 2004).

### 2.14.3 Ecological sustainability

The characteristics of cocoa agriculture provide good opportunities for biodiversity and sustainable land-use. This is commonly recognized and there is little trouble finding the agro-forestry method that can be called ecologically sustainable. This involves shade grown cocoa trees, fertilized by organic waste from the trees above and animal dung. Problems arise when practices are deviated from this method, to give way for monoculture and intensification of the production. This happens mainly on (large) plantations or monoculture areas and on some small-scale farms. (Primal) forest areas are cleared for the plantations, resulting in big biodiversity losses. The crops become more susceptible to pests and diseases due to the monoculture method, therefore more pesticide use occurs. The intensive land use results in soil degradation. The overall lifetime of these systems is much shorter than those cultivated under traditional smallholder regimes because the soil gets depleted. The consequence is a continuing and accumulating deforestation. The ecological problems concerning cocoa growing have been attributed mainly to a monoculture large-scale plantation method of agro–forestry (ICCO, 2006).

Another problem arises when fumigation with methyl bromide or phospine is applied, to prevent moths and mould on the cocoa beans during transports. The UNEP Montreal Protocol concerning ozone layer depletion prohibits Methyl Bromide use. The enforcement of the Protocol on this matter is however not sufficient to prevent the gas from being used. Alternatives have been developed in a comprehensive research for food commodities (Bell, 2003), that involve heating/cooling, $CO_2$ use and altered transporting methods.

# CHAPTER THREE

# MATERIALS AND METHODS

## 3.1 Study area

The Upper Denkyira West District (UDW) is located at the north-western part of Central region with latitude 6° 09°N and longitude 2° 09°W. The district experiences semi-equatorial climatic conditions. Temperatures are generally high throughout the year with mean monthly temperatures ranging between 26℃ - 30℃ and mean annual temperature of 27℃. Double maxima rainfall regime is experienced in the district. The total annual rainfall is between 1250 mm and 1750 mm. The major rains occur between April and July whilst the minor rains occur between September and December. Relative humidity is high about 80% in the raining season and 20% in the dry season. Owing to the climatic conditions experienced in the district, the vegetation is naturally semi – deciduous forest. This kind of vegetation is characteristically made up of three layers; namely the undergrowth, the middle layer and the upper layer. Its economy depends largely on agriculture with about 80-90 % of the population depending directly or indirectly on Agriculture. The sector is however beset with problems ranging from cumbersome land tenure systems, inadequate institutional capacity to move agriculture forward and inadequate infrastructure in the areas of rural water rural transport, road network and postharvest infrastructure. The District has a population of about 60, 054 (GSS, 2010). About 80% of the farming population works on cocoa as a cash crop on commercial basis, maize, cassava, cocoyam, plantain, vegetables etc to feed the household. Fifteen (15%) of the farming population produces food crops on subsistence basis and oil palm and citrus as supplementary cash crop. Less than 105 are commercial farm animals and poultry producers and Fish farmers and non-traditional farmers of snail, grass cutters and beekeepers form only about 2% of the farming population. The District is bordered in the North West by Bibiani- Anhwiaso- Bekwai District, North East by Amansie West and Amansie Central Districts, South West by Wassa Amenfi East and Wassa Amenfi West districts and South by Upper Denkyira East Municipal.

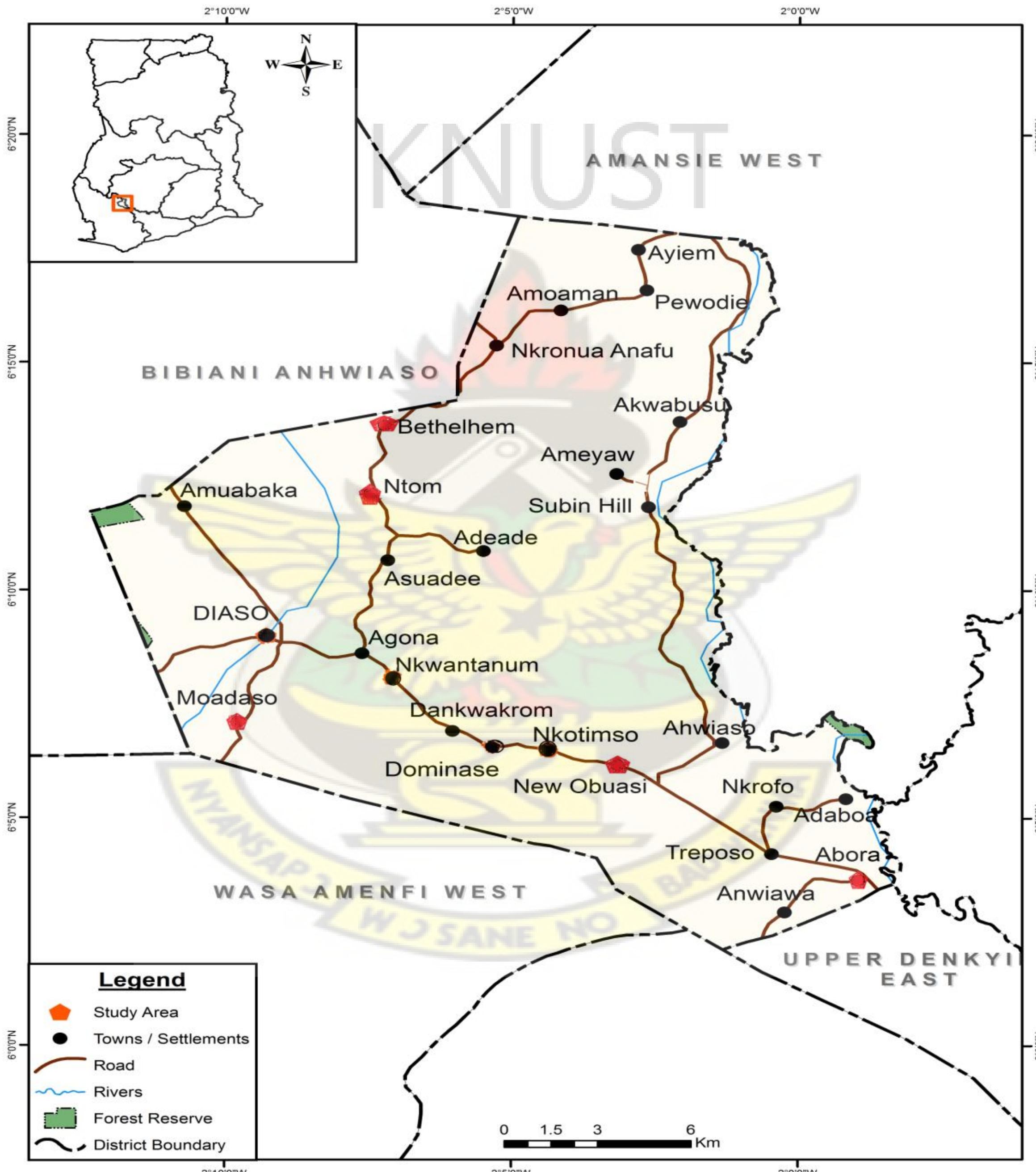


Figure 1: The District map of Upper Denkyira West, Source: Geography Department, UCC

## 3.2 Methods of Sampling

### 3.2.1 Soil chemical analysis

The soil samples were collected from five randomly selected cocoa communities in Denkyira Abora, Ntom, Bethlehem, Modoso, and New Obuasi in the district. Under each of the production system, 15 different farms were selected for soil chemical analysis in the study. On each farm, 5 cores of 15cm depth were randomly sampled and bulked together and subsample of 100g was taken to the Soil Science Laboratory of Crop and Soil Sciences Department of Faculty of Agriculture, Kwame Nkrumah University of Science and Technology, Kumasi for analysis.

### 3.2.2 Shade trees per cent cover per acre

One (1) acre size farm was demarcated and number of trees counted. The processes were replicated and average number of shade trees per acre determined. The percent shade trees cover per acre was determined by dividing average number of trees by minimum of shade per acre (six trees per acre). The ratio obtained was multiply by 100 to obtained per cent shade cover on the farm per acre.

### 3.2.3 Farm Profitability Estimates

To determine the profitability of cocoa production systems, the following parameters was considered: the cost involved in managing farms (farm inputs used – fertilizers, insecticides, fungicides, herbicides; labor – farm maintenance, spraying, harvesting and postharvest operations and transportations) and yield or income per acreage (revenue obtained from the sale of certified beans including the additional income arising from the premium and revenue obtained from the sale of conventional beans). The profitability indicators estimated were benefit-cost ratios (BCR), net present values (NPV) and internal rates of return (IRR).

### 3.2.4 Design of Socioeconomic Survey

Formal socio-economic sample surveys of 150 cocoa farmers were selected randomly from five cocoa communities in the Upper Denkyira West District of Ghana. Structured questionnaires for the individual interviews to fifty respondents were administered each to Utz Certified, Rainforest Alliance Certified and Conventional farms to evaluate the perception of farmers on the impact of certification schemes on sustainable cocoa production.

Firstly, structured interview was designed to evaluate the use of approved crop protection products and management practices by farmers on the following parameters/indicators; the use of crop protective products based on WHO and CRIG recommendations, record keeping on agrochemical usage; quantity/acre, methods of agrochemical application and the equipments used and the alternative preventive measures against pests and diseases other than chemicals.

Secondly, an interview was conducted to verify the level of compliance level of the farmers on health and safety practices in cocoa production based on; safe storage of agrochemicals, use of personal protection equipment for handling and application of organic and inorganic farm inputs, number of hours spent in applying agrochemicals in the field, type of training received on handling and application of hazardous crop protective products, creation of buffer zones (distances between production areas and terrestrial ecosystem, aquatic ecosystem and area of human activity from agrochemical spray), re-entry intervals (how people are protected from entering recently sprayed areas by displacing all information, safety instructions) and precautionary measures when carrying out hazardous work.

Finally, well structured interview questions addressing farm characteristics, production methods, labour practices, the nature of work and social aspects was designed to test the level of compliance to child labour in cocoa production systems in reference to ILO Convention 182 on the Worst Form of Child labour addressing “which work by its nature or the circumstances in which it is carried out, is likely to harm the health, safety or morals of children” and ILO Convention 138 on Minimum Age.

### 3.3 Data collection

Information for the study was collected at the district level. Economic, environmental and social outcomes were considered diagnostic criteria for determining partial indexes of sustainability. Data on farm inputs, cultivated surface by crop and crop production costs were obtained through interviews with farmers and references on the input invoices and receipt. However yield data was taken from cocoa farmer passbook.

#### 3.3.1 Economic outcomes

Economic sustainability, as the prerequisite for continued productive activity, forms the practical foundation of any approach to sustainable development. However, in the cocoa sector, as in other agricultural production systems, economic sustainability is not merely about maintaining productive activity - but rather about directly maintaining the livelihoods, environment and social needs of rural communities who often have little opportunity for other sources of revenue generation. The direct link between cocoa production and survival at the household and community levels gives the economic component of sustainability a special primacy in the assessment of the costs and benefits of sustainability initiatives operative in the cocoa sector. The study measured economic sustainability along the following broad parameters:

- ✓ Income;
- ✓ Production, and marketing costs
- ✓ Farm management;
- ✓ Additional income or revenue margins and

- ✓ Profitability

### 3.3.2 Environmental outcomes

The study methodology included a wide range of interview questions and soil chemical analysis designed to measure farms' environmental status and performance. The main categories covered by study's environmental analysis include measures on:

- ✓ Soil resource management;
- ✓ Water management (evidence of water conservation practices);
- ✓ Biodiversity and resource management (percentage and diversity);
- ✓ Pollution reduction (record keeping, products and chemicals applied, IPM)

### 3.3.3 Social outcomes

Social outcomes are intrinsically difficult to quantify, because of diverse causal variables and the difficulty of precise calculation. This study considers the following key indicators of social sustainability:

- ✓ Health and safety;
- ✓ Working hours and;
- ✓ Farm labor characteristic

## 3.4 Analysis of soil chemical properties

Soil chemical properties analyzed for the study includes pH, organic carbon, organic matter, total nitrogen, available phosphorus and exchangeable potassium.

### 3.4.1 Soil pH

Soil pH was determined in 1: 2.5 suspensions of soil and water using a pH meter. Twenty grams soil sample was weighed into 100ml polythene bottles. To this 50 ml distilled water was added and the bottle shaken for two hours. After calibrating the pH meter with buffer solutions of pH 4.0 and 7.0, the pH was read by immersing the glass electrode into the upper part of the suspension by an electrometric pH meter.

### 3.4.2 Soil organic carbon

Organic carbon was determined by the Walkley and Black wet combustion method (Nelson and Sommers, 1982). One gram of soil sample was weighed into a 400 ml flask and 10 ml of 1 N potassium dichromate ($K_2Cr_2O_7$) added followed by 96% concentrated sulphuric ($H_2SO_4$) acid. This was swirled to ensure contact with all the soil particles. The flask was made to stand on an asbestos sheet for 30 minutes to cool. Ten (10) ml of 85% ortho-phosphoric acid ($H_3PO_4$) and 2 ml of barium diphenylamine indicator were added. The solution was titrated with 1.0 N ferrous sulphate ($FeSO_4$) for a colour change from blue to bright green end point. A blank titration was carried out without soil. Percentage carbon was calculated as:

$$\% C = \frac{1N\ FeSO4 \times (V1 - V2) \times 0.39}{W}$$

Where:

I*N* $FeSO_4$ = normally of $FeSO_4$ used for titration

$V_1$ = ml for blank titration

$V_2$ = ml for sample titration

W = weight of soil sample used.

0.39 = 0.001 × 100% × 1.3 × 3 (3 = equivalent weight of C)

1. 3= a composition factor for the incomplete combustion of the organic matter.

Per cent organic matter was obtained by multiplying the per cent carbon by van Bemmelen factor of 1.724

### 3.4.3 Total nitrogen

Total nitrogen was determined by the modified Kjeldahl digestion method (Okalebo et al., 1993). In this method, 10 g of soil was digested with 30ml concentrated sulphuric acid, using a catalyst tablet of sodium sulphate (2), copper sulphate (1) and selenium (1). Digestion was followed by the Kjeldahl distillation process, using 40% caustic soda solution (NaOH) to distil ammonia which was received into 4% boric acid. Titration was done using 0.1 N HCl.



Calculation:

$$\% N = \frac{N \times (a - b) \times 14\, mcf}{S}$$

Where:

N = Normality of the HCl use in the titration

a = volume of standard HCl used in sample titration

b = volume of standard HCl used in blank titration

S = weight of air-dry sample (g)

mcf = moisture correction factor (100 + %moisture)/100

1.4 = 14 × 0.001 × 100% (14 = atomic weight of nitrogen)

### 3.4.4 Available phosphorus

The readily available acid-soluble forms of P were extracted with HCl: $NH_4F$ mixture. The Bray P1 method was used (Bray and Kurtz, 1945; Olsen and Sommers, 1982). Phosphorus in the extract was determined by the blue ammonium molybate method with ascorbic acid as reducing agent. Two grams soil sample was weighed into a shaking bottle (50ml) and 20ml of extracting solution of Bray-1 (0.03 *M* $NH_4F$ and 0.025 *M* HCl) was added. The sample was shaken for one minute by hand and immediately filtered through Whatman No. 42 filter. One ml of the standard series, the blank and the extract, 2 ml boric acid and 3 ml of the colouring reagent (ammonium molybdate and antimony titrate solution) were pipette into a test tube and homogenized. The solution was allowed to stand for 15 minutes for the colour to develop to its maximum. The absorbance was measured on a spectronic 21D spectrometer at 660nm wavelength.

A standard series of 0, 1.2, 2.4, 3.6, 4.8 and 6 mgP/l was prepared from a 12 mgP/l stock solution by diluting 0, 10, 20, 30, 40 and 50 ml of the stock solution in 100 ml volumetric flask and made to volume with distilled water. Aliquots of 0, 1, 2, 4, 5 and 6 ml of the 100 mg P/l of the standard solution were put in 100 ml volumetric flasks and made to 100ml mark with distilled water.

Calculations:

$$P\ (mg/kg) = \frac{(a-b) \times 20 \times 6 \times mcf}{S}$$

Where:

a = mg/l P in sample extract

b = mg/l P in blank

S = sample weight in (g)

mcf = moisture correcting factor

20 = ml extracting solution

6 = ml final sample solution

### 3.4.5 Exchangeable potassium

Potassium and sodium in the percolate were determined by flame photometry (Okalebo et al., 1993). A standard series of potassium and sodium were prepared by diluting 1000mg/l of potassium and sodium to 100mg/l. This was done by taking a 25ml portion of each into one 250ml volumetric flask and made to volume with water. Portions of 0, 5, 10, 15, and 20ml of the 100ml standard solution were put into 200ml volumetric flask respectively. One hundred millilitres of 1.0 M $NH_4OAc$ solution was added to each flask and made to volume with distilled water. The standard series obtained were 0, 2.5, 5.0, 7.5, 10.0 ml/l for potassium and sodium. Potassium and sodium were measured directly in the percolate by flame photometry at wavelength of 766.5 and 589.0 nm respectively 1.0 M KCL solution added. The bottle was capped and shaken for 2.0 hours and then filtered. Fifty millilitres (50ml) portion of the filtrate was taken with a pipette into a 250 ml Erlenmeyer flask and 2-3 drops of phenolphthalein indicator solution added. The solution was titrated with 0.1 M NaOH until the colour just turned permanently pink. A blank was included in the titration.

Calculation

$$\text{Exchangeable K } (cmol^{+}/\,kg\ soil) = \frac{(a-b)\times 250\times\ mcf}{10\times 39.1\ \times S}$$

Where:

a = mg/l of K in the diluted sample percolate

b = mg/l of K in the diluted blank percolate

S = air –dried sample weight of the soil in gram

mcf = moisture correcting factor

39.1= Molar mass for potassium

### 3.5 Experimental designs and data analysis

Randomized Complete Block Design (RCBD) with five blocks was used for the experiment. It was replicated five times. All soil chemical analysis data collected were subjected to Analysis of Variance (ANOVA) and LSD at 5% by GENSTAT was used was used to compare the significance difference among the means.

The socioeconomic survey data were analyzed using the Microsoft Excel computer spreadsheet software and SPSS. The profitability indicators estimated were benefit-cost ratios (B/C ratio), net present values (NPV) and internal rates of return (IRR). A 10% discount rate was used in assessing the profitability of the technology (Gittinger, 1982). The IRR determines the discount rate that makes the net present worth of the incremental net benefit stream or incremental cash flow equal zero. It represents the maximum interest that a project could pay for the resources used if the project is to recover its investment and operating costs and still break even (Gittinger, 1982). The formal selection criterion for the net present value is to accept investments with NPV greater than zero. However, if the net present value works out to be negative, then at the chosen discount rate, the present worth of the revenue or benefit stream is less than the present value of the cost stream. Hence, the revenues are insufficient to allow for recovery of the investment. An investment is technically and economically feasible if the NPV is positive. The decision rule for BCR is that for any project to be economically viable, the ratio must be greater than unity. The discount rate used in calculating a project's worth is very crucial. The discount rate determines the value today of an amount received or paid out in the future. Table 1 summarizes the profitability indicators and respective decision criteria.

Table 1: Economic indicators used for profitability assessment

| Profitability Indicator | Formula | Decision Criteria |
|---|---|---|
| BCR | $\frac{\sum \text{Bt}}{(1+r)^t} \div \frac{\sum Ct}{(1+r)^t}$ | BCR ≥ 1.0 |
| NPV | $\sum_{t=0}^{t=n} \frac{(\text{Bt}-\text{Ct})}{(1+\text{r})^{\text{t}}}$ | NPV ≥ 0 |
| IRR | $\sum_{t=0}^{t=n} \frac{(\text{Bt}-\text{Ct})}{(1+\text{r})^{\text{t}}} = 0$ | IRR ≥ r |

B = benefit, C = cost, t = time in years/production period, r = discount rate, n = rotation length in year

## CHAPTER FOUR

## RESULTS

### 4.1 Environmental outcomes

The environmental parameters used for the study includes soil chemical properties, records keeping on quantity of agrochemical used, active ingredient of herbicide product applied, insecticides and fungicides used for disease control, application of integrated pest management, buffer zone and contamination control, shade tree percentage on the farm and shade tree management control plans.

#### 4.1.1 Soil chemical properties

Table 2: Levels of soil chemical properties in Utz Certified, RA and conventional farms

| **Treatments** | **pH** | **C %** | **OM %** | **N %** | **Avail. P mg/g** | **Exc. K $cmol^+/kg$** |
|---|---|---|---|---|---|---|
| Utz Certified 1 | 6.01 | 2.028**a** | 3.524 | 0.196 | 7.520 | 0.540 |
| Utz Certified 2 | 5.26 | 2.214 | 3.446 | 0.24 | 7.540 | 0.440**b** |
| Utz Certified 3 | 6.55 | 2.413 | 3.452 | 0.238 | 11.05 | 0.436**b** |
| Average | **5.94** | **2.218** | **3.474** | **0.225** | **8.703** | **0.472** |
| Rainforest Alliance 1 | 6.15 | 2.472 | 3.556 | 0.248 | 8.440 | 0.708**b** |
| Rainforest Alliance 2 | 5.54 | 2.650 | 3.198 | 0.222 | 8.630 | 0.574 |
| Rainforest Alliance 3 | 6.07 | 3.830**a** | 3.578 | 0.22 | 7.590 | 0.591 |
| Average | **5.92** | **2.984** | **3.444** | **0.230** | **8.220** | **0.624** |
| Conventional 1 | 5.67 | 0.988 | 1.098 | 0.196 | 2.890 | 0.142 |
| Conventional 2 | 6.20 | 0.911 | 1.140 | 0.224 | 2.590 | 0.104 |
| Conventional 3 | 6.02 | 1.092 | 1.016 | 0.238 | 2.150 | 0.164 |
| Average | **5.96** | **0.997** | **1.085** | **0.219** | **2.543** | **0.137** |
| Significant level | n.s | * | * | n.s | ** | * |
| LSD (0.05) | | 0.692 | 0.437 | | 4.801 | 0.228 |
| CV (%) | | 10.3 | 2.7 | | 40.8 | 26.1 |

n.s - no significant * - significant P<0.001 ** - significant P<0.005, a and b - significant between Utz Certified and RA Certified

The soil chemical analysis used for the study were soil pH, soil carbon (C), soil organic matter, (OM), percent total nitrogen (N), available phosphorus, (P) and exchangeable potassium (K). The level of percent C was significantly ($P<0.001$) higher in Rainforest Alliance Certified (2.984%) followed Utz Certified (2.218%) than the conventional farms (0.997%). The percent OM contents was significantly ($P<0.001$) higher in Utz Certified (3.474%) followed by Rainforest Alliance Certified farms (3.444%) than Conventional farms (1.085%). Also, the exchangeable K was significantly ($P<0.001$) higher in Rainforest Alliance Certified farms (0.624 cmol$^{+}$/kg) followed by Utz Certified (0.472 cmol$^{+}$/kg) than Conventional farms (0.137 cmol$^{+}$/kg). However, available P was significantly ($P<0.005$) higher in Utz Certified (8.703 mg/g) followed by Rainforest farms (8.220 mg/g) than the Conventional counterpart (2.543 mg/g). With the exception of the Rainforest Alliance Certified 3, percent C was significantly ($P<0.001$) higher than Utz Certified 1 (3.830% and 2.028%) respectively. The exchangeable K of Rainforest Alliance Certified 1 was also significantly ($P<0.001$) higher (0.708 cmol$^{+}$/kg) than Utz Certified 2 and Utz Certified 3 (0.440 cmol$^{+}$/kg) and (0.436 cmol$^{+}$/kg) respectively. All soil chemical properties analyzed for the study were not significantly different between Utz Certified and Rainforest Alliance Certified farms. The pH and total N content were not significantly different for the farms namely Utz Certified, Rainforest Alliance Certified and Conventional farms.

### 4.1.2 Records keeping on quantity of agrochemicals used

The document of providing evidence of activities performed (time and date of application, chemical used and equipment used) in relation to agrochemical used.

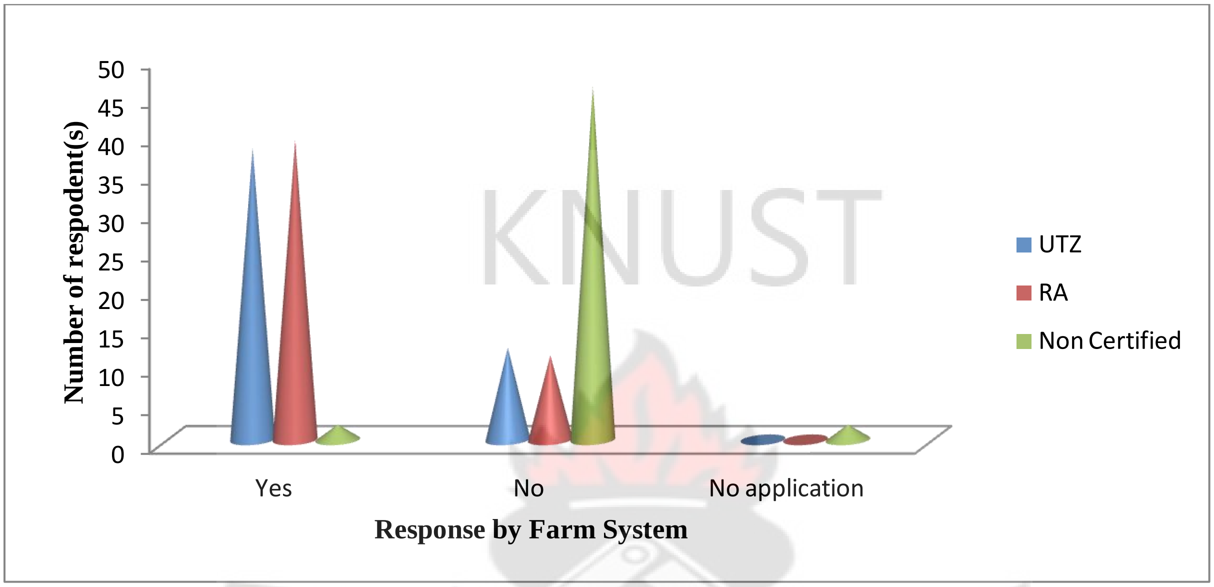


Figure 2: Records keeping on quantity of agrochemical used by different system of production

The overall findings show that those farms participating in a sustainability initiative had measurably better pollution prevention systems in place than their conventional counterparts. The score of 38 and 39 farmers keeping records on quantity of agrochemical used in RA and Utz Certified respectively show that farms participating in a sustainability initiative had measurably better systems in place than the conventional of two (2) farmers who keeps records.

### 4.1.3 Active ingredient of herbicide products applied

The study seeks to evaluate the approved and prohibited or banned active ingredients of herbicide used for by cocoa farmers. The approved active ingredient used for the study was glyphosate and banned included atrazine and paraquat.

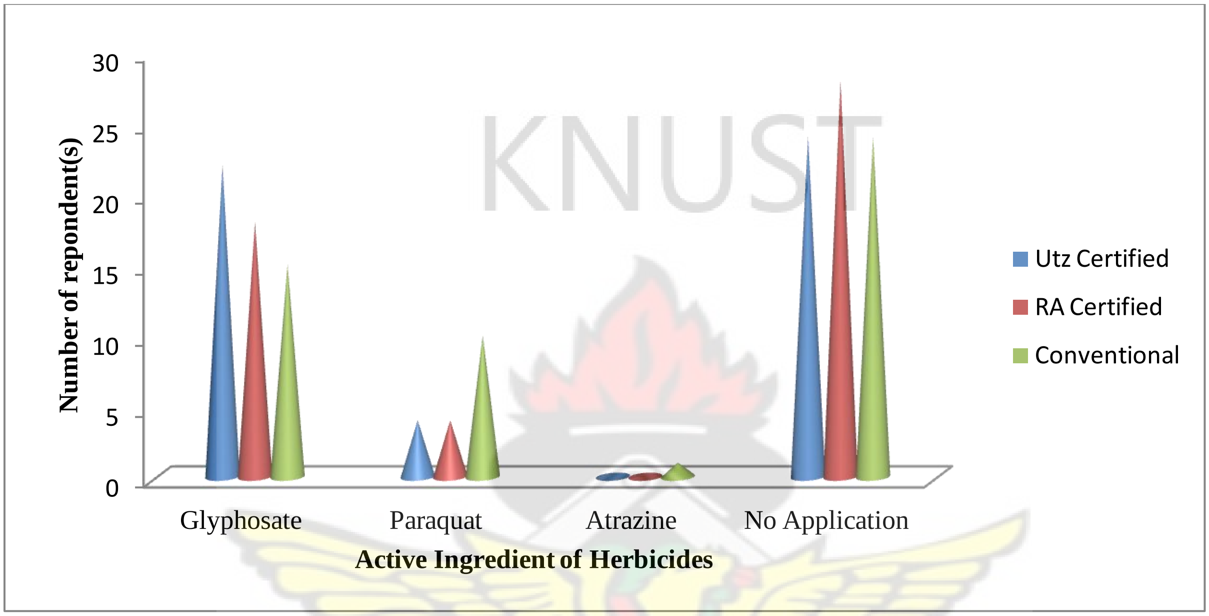


Figure 3: Active ingredients of herbicide used by farmers on their farm

Figure 3 has shows that 50% of the farmers sampled for the study used chemicals to control weeds on their farms. RA Certified, Utz Certified and conventional farms patronize in banned or prohibited herbicide (paraquat and atrazine) according to the WHO Class II technical grade active ingredients of pesticides. The highest number of ten (10) and one (1) conventional farmers used paraquat and atrazine respectively.

### 4.1.4 Active ingredient of insecticides and fungicides used for disease control

The active ingredient is the chemical that triggers in the treated organisms (insect, fungi etc) the specific toxic effect. The active ingredient for insecticide use for the study included imidacloprid, bifenthrin and thiamethoxam. The fungicides included cuprous oxide, metalaxyl-M + cuprous oxide, copper hydroxide and metalaxyl+cooper (1) 0xide.

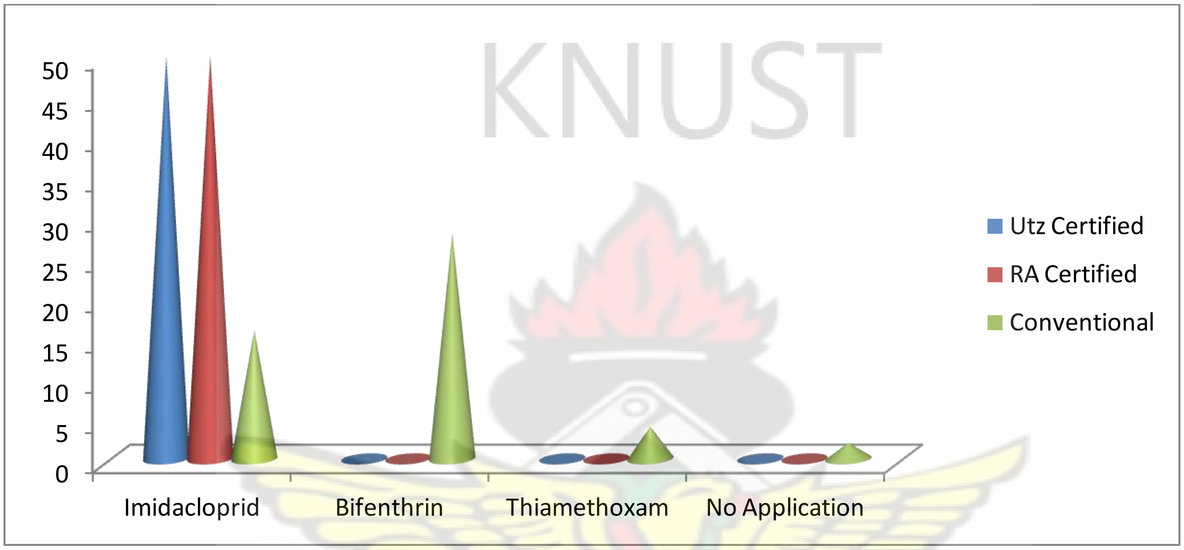


Figure 4: Active ingredient of insecticide used control of mirids on different farms

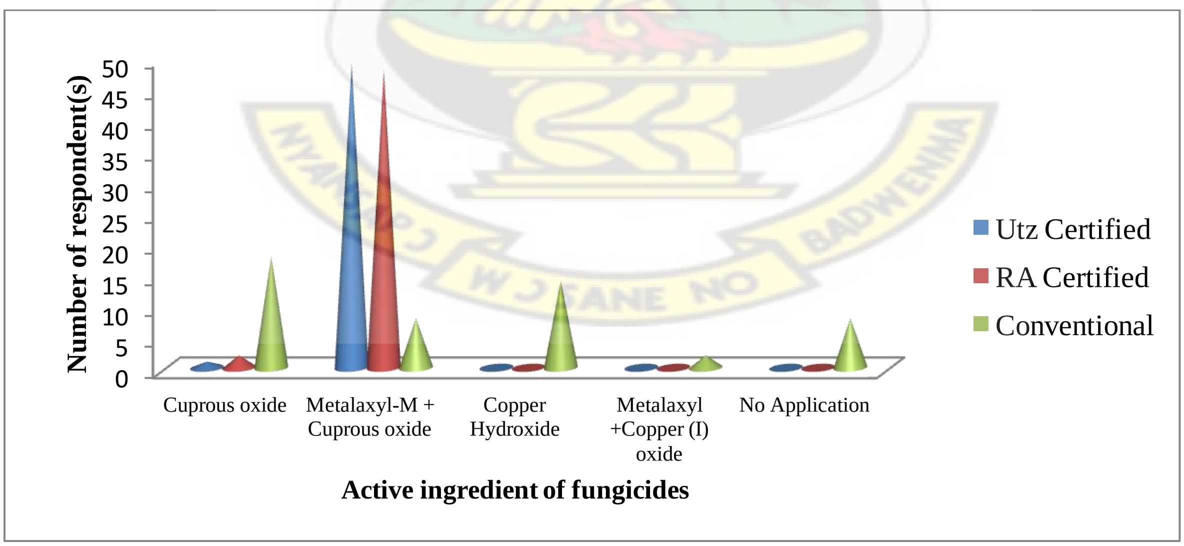


Figure 5: Active ingredient fungicide used for control of black pod disease on different farms

Comparing crop protection products in Figures 4 and 5 with the active ingredient of insecticides and fungicides respectively, approved by the by WHO technical grade of active ingredient and Cocoa Research Institute of Ghana (CRIG) on approved chemical for cocoa, the overall findings show that those farms participating in a sustainability initiative had has no relation in response to type of chemical use control mirids and black pod disease than their conventional counterparts. All active ingredients of insecticides and fungicide used were within the CRIG recommendations.



### 4.1.5 Application of integrated pest management (IPM)

The IPM is a long-term prevention strategy to combat pests, involving a combination of techniques, such as biological control (use of beneficial insects or microbes), use of crop-resistant varieties and the use of alternative agricultural practices (spraying, fertilizing or pruning). The objective of IPM is to make conditions less favorable for pest development. Pesticides are used only when the damage caused by pests is greater than the level that the farmer can economically sustain (economic threshold).

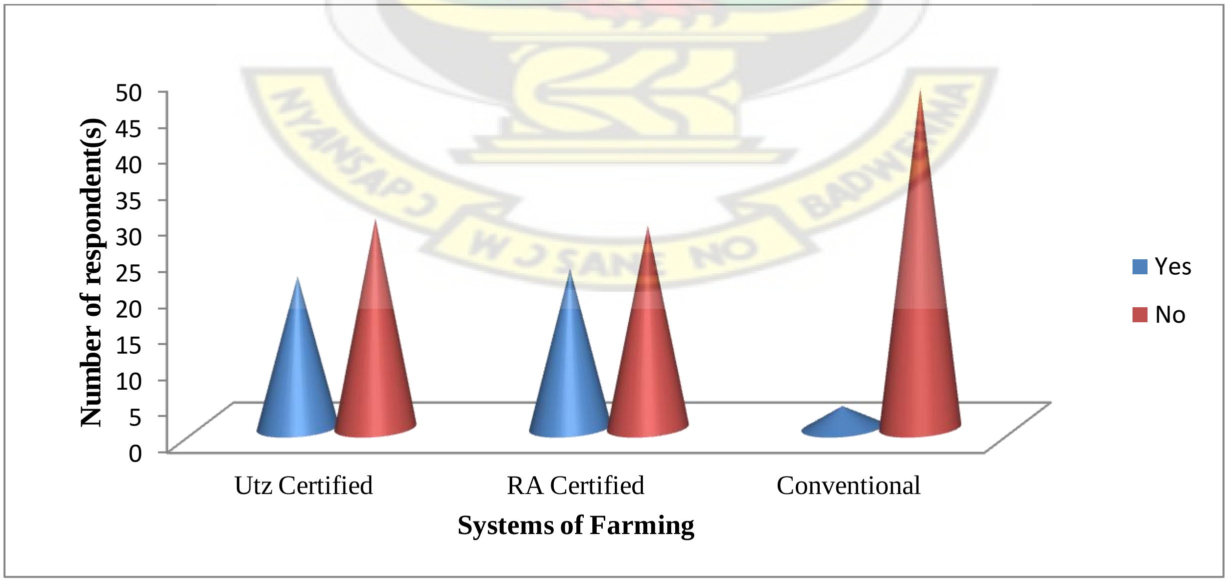


Figure 6: Application of other method to control black pod disease other than fungicides

From Figure 6, the RA and Utz Certified farms used other methods to control disease and pest other than chemical than the conventional farms with respect with 21, 22 and 3 farms for respectively.

### 4.1.6 Buffer zone and contamination control

The buffer zone is the minimum application distance of pesticides and fertilizers observed by farmers between the treated area (farm) and aquatic ecosystems and human activity. This includes 15 feet (5 meters) from small streams and waterlogged areas, 32 feet (10 meters) from rivers or lakes and 48 feet (15 meters) from a spring.

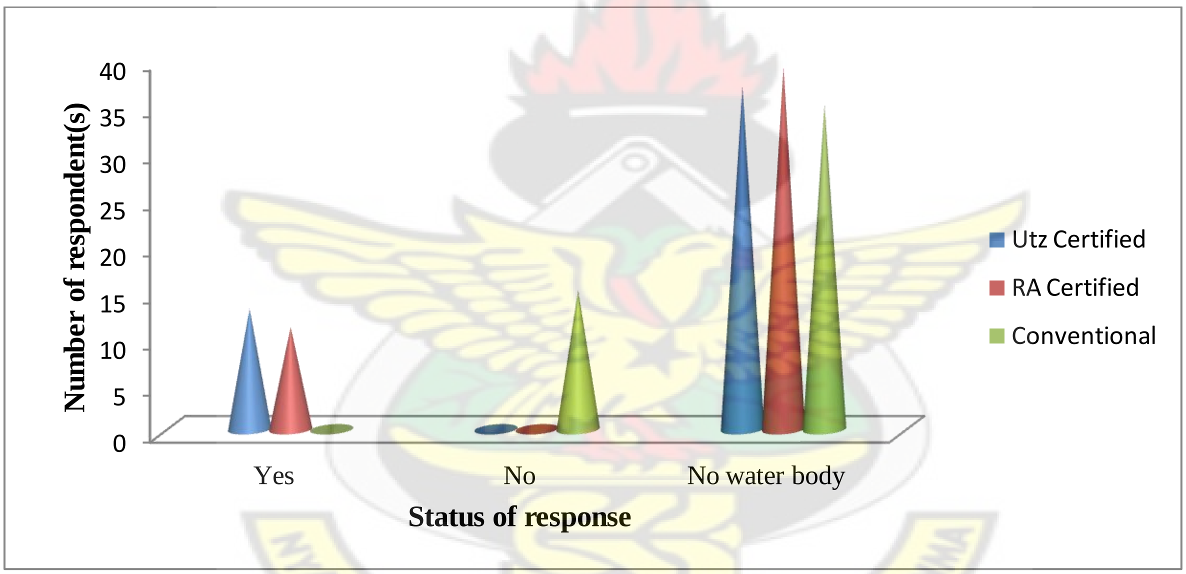


Figure 7: The minimum application distance (Buffer zone) of pesticides and liquid fertilizers observed by farmers to aquatic ecosystems and human activity

Figure 7 show that those farms participating in a sustainability initiative had measurably better pollution prevention systems in place than their conventional counterparts. Considering the applicability of this criterion, the number of 13 and 11 Utz Certified and RA Certified farms respectively have water bodies found on those farms. These certified farms have created buffer along water bodies to reduce drifts of agrochemical spray compared to 15 conventional farms with no buffer along water bodies.

### 4.1.7 Shade tree percentage on the farm

Table 3: Percent of shade tree cover on cocoa farms per acre

| Respondents status | Average number of trees per acre | Average shade tree cover/acre % |
|---|---|---|
| Utz Certified | 1.54 | 25.67 |
| Rainforest Alliance | 1.60 | 26.67 |
| Conventional | 1.37 | 22.83 |

The minimum biodiversity management scores for shade trees cover on the cocoa farm is 40% (or 6-9 trees per acre) shade cover. In table 3, all systems of production recorded below the 40% shade tree cover on the cocoa farm per acre. However, Rainforest Alliance obtained (26.67%) was higher followed by Utz Certified (25.67%) and conventional farms (22.83%). The little variation between conventional and RA Certified and Utz Certified farms overall, pointing to the likelihood that, for early periods of certification, there is usually little or effect on these measures.

### 4.1.8 Shade tree management control plans

Table 4: Control plans by number of farmers to increase shade trees on cocoa farm

| Respondent status | Supply nursery seedlings | Non supply nursery seedlings | No seedlings planted | Total |
|---|---|---|---|---|
| Utz Certified | 30 | 4 | 16 | 50 |
| Rainforest | 28 | 2 | 20 | 50 |
| Conventional | 0 | 17 | 33 | 50 |
| Total | **58** | **18** | **69** | **150** |

The control plan for tree density and the percentage of different categories of tree coverage on the farm, as such, biodiversity scores within the study are a function of both the number of trees per acre and the variety of tree species present on the farm. There was little variation between conventional, RA Certified and Utz Certified farms in respect to shade tree density on the farm. Therefore, in table 4, overall plan to increase shade trees density on their farm were high in Utz Certified (34 farmers) followed by Rainforest Alliance Certified (30 farmers) and conventional 17 farmers.

### 4.2 Social outcomes

Social outcomes for the study include child labor characteristics on the farm, agrochemical storage and use of personal protective equipment, working hours and re-entry time of agrochemicals spraying.

#### 4.2.1 Child labor characteristics on the farm

Table 5: Characteristics of task children performs in cocoa farms

| Respondent status | Fetching water/ removal of placenta from broken pods/ gathering pod | Handle and apply pesticides | Apply fertilizers | Use farm sharp tools | No work | Total |
|---|---|---|---|---|---|---|
| Utz Certified | 11 | 2 | 0 | 2 | 35 | 50 |
| Rainforest | 12 | 1 | 0 | 4 | 37 | 50 |
| Conventional | 8 | 3 | 0 | 7 | 32 | 50 |
| Total | **31** | **6** | **0** | **13** | **100** | **150** |

In table 5, Utz Certified, RA Certified and Conventional farms in one way engage their children to help in family farms. However, the types of activity carried by these children differ significantly between Utz Certified, RA Certified and conventional farms. The most significant gains by certified farms were in the number of children whose performed hazardous activity on farm is less compared to the conventional farms. Out of 150 respondents used for the study, only 19 respondents constituting 12.67% defiles the *Protocol for the Growing and Processing of Cocoa Beans and their Derivative Products in a Manner that Complies with ILO Convention 182*

*Concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labor*, to end the use of abusive child labor in cocoa production and *ILO Convention 138 on Minimum Age*. Of these 19 respondents, score 4, 5 and 10 farmers engaging in hazardous activities by their children on their farms occurs in Utz Certified, Rainforest Alliance Certified and Conventional farms respectively.

### 4.2.2 Agrochemical storage and use of personal protective equipment (PPE)

Table 6: Storage of agrochemicals

| Respondent status | Agro – store | Bedroom | Foodstuffs | No application | Total |
|---|---|---|---|---|---|
| Utz | 31 | 12 | 7 | 0 | 50 |
| Rainforest Alliance | 30 | 13 | 7 | 0 | 50 |
| Conventional | 13 | 22 | 13 | 2 | 50 |
| Total | **74** | **47** | **27** | **2** | **150** |

The analysis in table 6 shows that number of Utz Certified (31 farms) and Rainforest Alliance certified (30 farms) were higher than conventional (13 farms) with respect to the safe storage facilities for agrochemicals.

Table 7: Use of personal protective equipments for handling and applying agrochemicals by farmers

| Respondent status | Yes | No | No application | Total |
|---|---|---|---|---|
| Utz | 49 | 1 | 0 | 50 |
| Rainforest Alliance | 48 | 2 | 0 | 50 |
| Conventional | 21 | 27 | 2 | 50 |
| Total | **118** | **30** | **2** | **150** |

From table 7, the highest number of farmers that used appropriate protective equipments (overall, boot, nose mask, goggle, gloves and hat) when spraying agrochemicals safely occur in

Utz Certified (49 farmers) followed by Rainforest Alliance Certified (48 farmers) and the conventional (21 farmers).

### 4.2.3 Working hours and re-entry time of agrochemicals

The re-entry time is the minimum amount of time that must pass between the moment a pesticide was applied to area or crop and the moment that people can enter that area without personal protective equipment. The maximum working hours for spraying agrochemical is six per day.

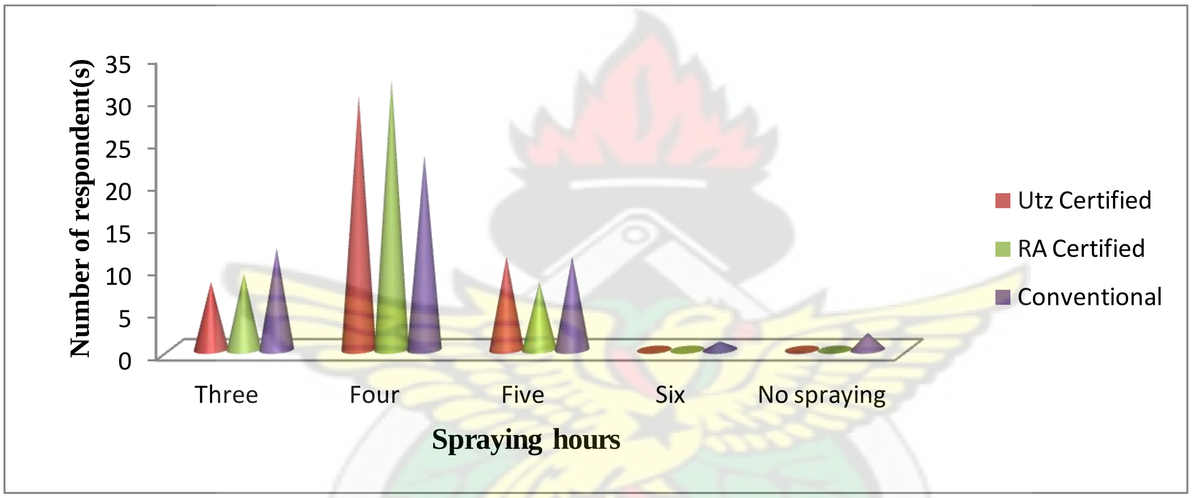


Figure 8: Working hours used for agrochemicals spraying

In figure 8, the certified and conventional farms had no significant effect with respect to number of working hours used for spraying agrochemical on the farm but significant higher with respect to re-entry time of chemical to reduce terrestrial toxicity in human as shown in figure 9.

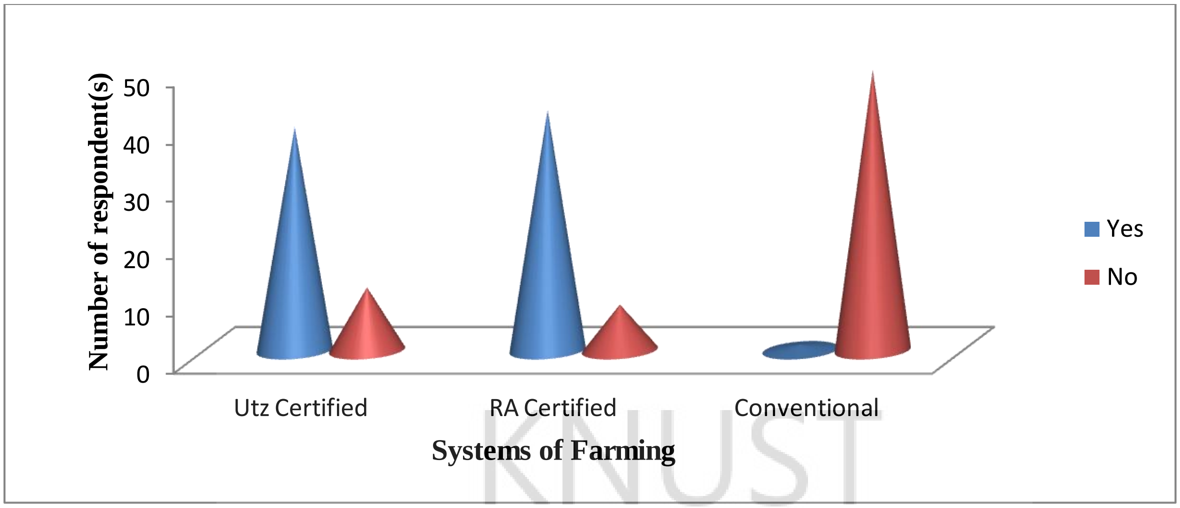


Figure 9: Re-entry time observed before, during and after spraying of agrochemicals

### 4.3 Economic outcomes

Profitability estimates / cost and benefit analysis was used as economic outcome of the study.

#### 4.3.1 Farm profitability estimates - cost and benefit analysis

The profitability estimates used for the study include: benefit cost ratio (BCR, net present values (NPV) and internal rates of return (IRR).

Table 8: Summary of profitability estimates for three cocoa production systems at 24% discount rate

| Economic Indicator | Conventional | Rainforest Alliance | UTZ |
|---|---|---|---|
| B/C Ratio | 1.18 | 1.34 | 1.26 |
| Max NPV(GH¢) | 139.8 | 184.11 | 163.27 |
| IRR | 30.50% | 54% | 52% |

Economic indicators estimated are the B/C ratio, NPV and IRR. The discounted cash flow results presented in Table 8 show that cocoa production is, in general, profitable at a 24% discount rate. However, the conventional system is the least profitable although it has the longest rotation. The certification effect decreased the BCR, NPV and IRR, from 1.34 and GH¢184.11, and 54% in the Rainforest Alliance system to 1.26, GH¢163.27, and 52% respectively in the

UTZ system, although both systems exhibit greatly improved financial performance compared to the conventional system of 1.18, GH¢139.8 and 30.5%.

# CHAPTER FIVE

# DISCUSSIONS

## 5.1 Environmental outcomes

### 5.1.1 Soil chemical properties

The results of the soil chemical properties was due to the fact that chemical fertilizers used in certified farms in their correct proportions and quantities compare to conventional farms. Also all chemical fertilizers applied on their farms contains the following chemical components [Asaase Wura-N.P.K 0:22:18 + 9CaO + 7S + $6MgO_{(S)}$, Cocofed-N.P.K 0:30:20 and Potassium Rich Liquid fertilizer-N.P.K 6:0:30 + 1MgO + trace elements]. Although the soil pH were not significant different among the treatments, the soil samples used for the study falls between the optimal ranged pH of 5.5 – 6.5. This means that availability of nutrients in the soil pool and to the cocoa plant not affected by the soil pH. Also, there were no significant differences between the percent total N in the soil samples.

### 5.1.2 Records keeping on the quantity of agrochemicals used

The measures to assess the level of pollution associated with a given farm's practices in relation to records to register quantity of agrochemical used. The high number of certified farms with records on agrochemical used focus on tracking the existence of management systems, waste reduction measures and evidence of safe chemical use procedures. This finding was largely the emphasis that the sustainability initiatives place on improved farm management systems.

### 5.1.3 Active ingredient of herbicide products applied

Banned and prohibited agrochemicals are still been sold in this country through porous borders and farmers patronize these chemicals because they are cheaper than the approved ones. A review of ten years of Fair-trade studies also suggests that certification is often associated with the use of approved agro-chemicals and the safer use of them (Nelson and Pound, 2009). Research in Ecuador compared 23 certified farms, including ten farms certified to Rainforest Alliance standards, with 24 noncertified control farms. Using Likert-scale measures of environmental "risks" related to land management, water quality, agrochemical management, and waste management, the authors found that certified farms generate lower environmental risks than noncertified farms (Melo and Wolf, 2007).

### 5.1.4 Active ingredient of insecticides and fungicides used for disease control

While non-chemical means of managing pests and diseases in the cocoa industry are widely recommended for health and other reasons, the use of some amounts of chemicals in the form of fertilizers, insecticides and fungicides is unavoidable in the effective management of cocoa farms (Moy and Wessel, 2000; Opoku *et al*., 2007; Adjinah and Opoku, 2010). The availability of insecticides and fungicides to farmers were as a result of the government of Ghana policy which introduced the national Cocoa Diseases and Pests Control Program, CODAPEC, to combat the resurgence of mirids and black pod diseases on cocoa farms. This opportunity was also to be used to train farmers and technical personnel in the scientific methods of pests and diseases control (Adjinah and Opoku, 2010).

### 5.1.5 Application of integrated pest management (IPM)

The goal of maintaining high levels of agricultural productivity and profitability while reducing pesticides use presents a significant challenge. There are repeated cases of excessive levels of pesticide residues being found in agricultural produce and the safety of these products has become an issue of concern. Recently, changes in regulations in the European Union (EU), North America and Japan have called for a reflection on crop protection practices in cocoa and other commodity crops. The quality of cocoa imported into the EU and elsewhere will be assessed based on traces of pesticides and other substances that have been used in the supply chain. Therefore there is need to compare the use of other method (IPM) of control cocoa disease in the study.



### 5.1.6 Buffer zone and contamination control

Freshwater aquatic and human toxicity by chemical as result of spray drift are not limited exclusively to the cocoa production stage, and have the highest numerical values in the figure, which makes them more significant than the others. The Utz Certified and RA Certified farms have appropriate buffer zone (distances between production areas and terrestrial ecosystem, aquatic ecosystem and area of human activity from agrochemical spray) in place to reduce agrochemical contamination to water bodies found on their farm than the conventional farms. The buffer helps in reducing toxicity to humans, flora and fauna caused by a variety of substances, ranging from carcinogens to persistent toxins such as heavy metals which find their way into the food chain. The probability that exists for harmful chemicals directly or indirectly poisoning some organisms and ultimately eliminating them from the ecosystem, and thereby restricting the biodiversity of the region and upsetting the food chain is minimize in certified farms.

### 5.1.7 Shade tree percentage on the farm

The study measures of biodiversity management look at the quantity and quality of natural vegetation with trees as a key indicator. More specifically, the study measured tree density and the percentage of different categories of tree coverage on the farm. As such, biodiversity scores within study were a function of both the number of trees per acre and the variety of tree species present on the farm. The low shade tree cover in cocoa plantations in Ghana was due to results from several studies at Cocoa Research Institute of Ghana (CRIG) in which shade and fertilizer levels were varied led to extension recommendations to reduce or entirely eliminate shade trees and apply fertilizer (Ahenkorah *et al*., 1974; Ahenkorah *et al*., 1987). This low shade recommendation was widely followed in the rapid expansion of the sector in the 1980s and 1990s fertilizer recommendations have largely been ignored due to a combination of underdeveloped fertilizer and credit markets in Ghana (Gockowski and Sonwa, 2008). A study of forest certification in Bolivia, for example, documented limited improvement in specific forest management practices following certification, with deforestation, overall, continuing (Nebel *et al*., 2005).

### 5.1.8 Shade tree management control plans

The yearly shade tree distribution program the certificate holders embark in order to comply with Utz control point number 20 and SAN-RA standard criterion 2.8 which requires (farms with agro-forestry crops located in areas where the original natural vegetative cover is forest must maintain a permanent agro-forestry system distributed homogenously through the plantations with tree community of cultivated land consisting of 12 native species per hectare on average and the density of the cultivated land is at least 40% (SAN-RA, 2009) and at least 18 mature shade trees per hectare disperse on their farms in Utz Code of Conduct (2009). This confirm a 2009 study of plantation forests in the southern part of Brazil (Rio Grande do Sul and Santa Catarina) compared variables on seven Rainforest Alliance-certified operations and seven noncertified operations, using a combination of field observations, interviews with owners, and interviews with workers. The research found that certified forestry operations outperformed noncertified on species control plan (present in 100 percent of certified operations and in 33 percent of noncertified) and planting with tree species (71 percent of certified; 50 percent of noncertified) (Barbosa de Lima *et al*., 2009).

## 5.2 Social Outcomes

### 5.2.1 Child labor characteristics on the farm

The cocoa industry has profited from the utilization of child labour in West Africa. While the number of forced child laborers may be disputed, children are undoubtedly involved in hazardous activities and subjected to mistreatment. Children typically perform the same arduous tasks and work the same hours as adults, but receive less pay. Tasks include transporting heavy loads, pesticide and fertilizer application, and the use of machetes. The extent to which cocoa producers in Ghana employ child labor is, in part, a function of economic factors and these include low cocoa prices, low incomes of family farmers, and large numbers of small holder farmers who cannot afford to engage hired labor. Lack of adequate school facilities in cocoa producing areas also plays a role and cultural factors are involved too.

### 5.2.2 Agrochemical storage and use of personal protective equipment (PPE)

The designed, constructed and equipped agro-store is to reduce the risk of accidents and negative impacts on human health and the environment. In Kenya, a study of Eurep G.A.P (a voluntary standard for food safety and farm management practices, now called Global G.A.P.) noted that, apart from financial benefits, adopters also benefited from improved hygiene and safety on the farm (Asfaw *et al*., 2010).

Terrestrial toxicity, though not of the same magnitude as freshwater aquatic toxicity, is nevertheless important. Therefore probability that exists for harmful chemicals directly or indirectly poisoning some organisms and ultimately eliminating them from the ecosystem is reduced. Arnould and colleagues' study of small producers in Fair-trade cooperatives with matched controls in Nicaragua, Peru, and Guatemala documented significant positive impacts of certification on education and health (Arnould *et al*., 2009).



### 5.2.3 Working hours and re-entry time of agrochemicals

The extent of relationship between certification and working hours and re-entry time (how people are protected from entering recently sprayed areas by displacing all information, safety instructions), such a relationship is explained by the combined effects of ongoing farm level monitoring (audits associated with certification) as well as the implementation of improved management systems.

## 5.3 Economic outcomes

### 5.3.1 Farm profitability estimates - cost and benefit analysis

Duguma *et al*. (2001) reported that, even with no value assigned to the tree species, cocoa production in smallholder systems in Cameroon was profitable, with production being more profitable with planted shade trees. Many certification systems require environmental management techniques that sometimes reduce yield. In some cases, the cost savings and any premium earned (even through guaranteed-premium systems like Fairtrade) might not make up for that loss in yield. Overall, the effects of standards on yield and quality are variable and difficult to attribute to the standard per se, since most study designs are confounded by possible differences in preexisting conditions.

# CHAPTER SIX

# CONCLUSIONS AND RECOMMENDATIONS

## 6.1 Summary

This study approach to sustainability assessment allows it to be an effective farm management and policy management tool by providing a sound quantitative basis for comparison and evaluation of the effect of sustainability interventions. The variances between the various certification systems may often be explained by site-specific considerations, especially local geographical and organizational conditions that can play a significant role in determining the performance of farms. Turning to the review of the content of the different farms, system criteria of the study surveyed are dominated by environmental and social, rather than economic, requirements.

## 6.2 Conclusions

The study established that the impact of voluntary sustainability initiatives (VSIs) on soil chemicals properties (C, OM, P and K) were significant higher in Utz and RA farms, however, soil pH and N were not significant impact among the treatments. For pollution control indexes, certified farms shows the degree of significant differences from the conventional farms with respect to protection of water bodies (buffer zones), records on the quantity of agrochemical used and active ingredient of herbicide used but no difference were found in the active ingredient of insecticides and fungicides used to control mirids and black pod disease of cocoa respectively. Similarly, the study established that there was little evidence that certification on the observed farms had a significant effect on key indicators such as biodiversity and shade coverage, however differ significantly respect to control plans to increase shade trees on the farm.

On social parameters, the study established that though both certified and conventional farms used their children to performed hazardous activity on their farms, the degree of occurrences was significantly higher in conventional farms than in certified farms.

For occupational health and safety indexes, number of certified farms was significantly higher from the conventional farms in respect to appropriate storage of agrochemicals and use of personal protective equipment (PPE) for spraying agrochemicals.

However, no significant differences were found in working hours used for chemical spraying between certified and conventional farms but significantly higher with respect to re-entry time of chemical to reduce terrestrial toxicity in human.

On the economic frontier, the study concludes that, with conventional cocoa farms, cocoa production is profitable. The introduction of cocoa certification greatly enhances profitability. However, the certified farms systems exhibit greatly improved financial performance (B/C Ratio/ NPV and IRR) compared to the conventional system but the gap is narrow.

**5.2 Recommendations**

The study established that there is a need for significant expansion of the certification program in order to generate more statistically significant results. To increase the value of the certification process on sustainable cocoa production in Ghana, several actions need to be undertaken:

a. The generation of an internal and ongoing measurement system among farmer groups in collaboration with local institutions;
b. The development of an open access database on sustainability initiatives for policy-makers and producers in order to enable more strategic business, risk and quality management in the adoption sustainable practices;

c. The generation of concrete commitments from the international community to establish a secretariat to facilitate the gathering and management of credible scientific measurements on sustainability impacts of market initiatives;

d. Collaborative effort by private input dealers and Ghana Cocoa Board public extension division to provide capacity building and training programs to cocoa farmers on occupational health in the cocoa industry. The study recommends these programs must emphasize on crop protection and management practices, health and safety practices and inform farmers on safe and rational use of agrochemicals;

e. Nursery centers for recommended shade trees must be established in all cocoa districts by appropriate institutions such as Forestry Commission, Forest Research Institute of Ghana and other stakeholders in the supply chain to be distributed to farmer to increase shade tree cover on their farms;

f. Both government and the private sector have to provide and expand technical assistance-oriented initiatives to address sustainability challenges and promote a more sustainable cocoa economy at the global level.

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# APPENDICES

## Appendix A. Raw Data – Soil Chemical Analysis

### NTOM COMMUNITY

| NUMBER | SAMPLE ID | pH | % TOTAL N | AVAIL P (mg/kg) | K (cmol/kg | % O.C. | %O.M. |
|---|---|---|---|---|---|---|---|
| 1 | RA1 | 7.81 | 0.27 | 9.87 | 0.67 | 2.25 | 3.89 |
| 2 | RA 2 | 6.6 | 0.29 | 9.97 | 0.78 | 1.95 | 3.4 |
| 3 | RA 3 | 7.73 | 0.36 | 10.72 | 0.69 | 2.84 | 3.1 |
| 4 | UTZ 1 | 6.75 | 0.28 | 11.78 | 0.55 | 1.96 | 3.37 |
| 5 | UTZ 2 | 7.84 | 0.24 | 16.72 | 0.72 | 2.59 | 2.58 |
| 6 | UTZ 3 | 7.88 | 0.21 | 26.53 | 0.69 | 1.96 | 3.37 |
| 7 | Conv. 1 | 5.15 | 0.16 | 3.41 | 0.05 | 1.26 | 1.03 |
| 8 | Conv. 2 | 5.25 | 0.19 | 3.08 | 0.11 | 0.15 | 1.71 |
| 9 | Conv. 3 | 4.98 | 0.18 | 3.68 | 0.16 | 1.06 | 1.05 |

### NEW OBUASI COMMUNITY

| NUMBER | SAMPLE ID | pH | % TOTAL N | AVAIL P (mg/kg) | K (cmol/kg | % O.C. | %O.M. |
|---|---|---|---|---|---|---|---|
| 1 | RA1 | 6.19 | 0.24 | 4.96 | 1.01 | 2.71 | 3.47 |
| 2 | RA 2 | 4.85 | 0.14 | 4.41 | 0.94 | 3.72 | 2.96 |
| 3 | RA 3 | 6.2 | 0.23 | 4.41 | 0.85 | 2.63 | 3.68 |
| 4 | UTZ 1 | 5.69 | 0.14 | 6.96 | 0.91 | 1.72 | 2.96 |
| 5 | UTZ 2 | 5.76 | 0.21 | 5.96 | 0.35 | 2.13 | 3.68 |
| 6 | UTZ 3 | 6.42 | 0.27 | 6.25 | 0.44 | 1.98 | 3.4 |
| 7 | Conv. 1 | 5.3 | 0.18 | 3.08 | 0.03 | 0.23 | 0.85 |
| 8 | Conv. 2 | 6.58 | 0.33 | 3.96 | 0.11 | 1.16 | 1.21 |
| 9 | Conv. 3 | 6.9 | 0.11 | 3.08 | 0.13 | 1.06 | 1.07 |

**DENKYIRA ABORA COMMUNITY**

| NUMBER | SAMPLE ID | pH | % TOTAL N | AVAIL P (mg/kg) | K (cmol/kg | % O.C. | %O.M. |
|---|---|---|---|---|---|---|---|
| 1 | RA1 | 5.41 | 0.33 | 15.74 | 0.32 | 3.03 | 3.68 |
| 2 | RA 2 | 5.47 | 0.27 | 16.94 | 0.41 | 2.13 | 3.68 |
| 3 | RA 3 | 6.2 | 0.25 | 10.22 | 0.29 | 2.13 | 3.68 |
| 4 | UTZ 1 | 5.96 | 0.29 | 6.92 | 0.37 | 2.13 | 3.68 |
| 5 | UTZ 2 | 5.93 | 0.38 | 7.27 | 0.49 | 2.07 | 3.58 |
| 6 | UTZ 3 | 5.83 | 0.28 | 6.52 | 0.37 | 3.21 | 3.82 |
| 7 | Conv. 1 | 6.12 | 0.09 | 2.68 | 0.28 | 2.15 | 1.01 |
| 8 | Conv. 2 | 6.28 | 0.21 | 1.37 | 0.03 | 1.01 | 1.05 |
| 9 | Conv. 3 | 6.28 | 0.14 | 0.96 | 0.18 | 2.15 | 0.71 |

**BETHELHEM COMMUNITY**

| NUMBER | SAMPLE ID | pH | % TOTAL N | AVAIL P (mg/kg) | K (cmol/kg | % O.C. | %O.M. |
|---|---|---|---|---|---|---|---|
| 1 | RA1 | 5.41 | 0.33 | 15.74 | 0.32 | 3.03 | 3.68 |
| 2 | RA 2 | 5.47 | 0.27 | 16.94 | 0.41 | 2.13 | 3.68 |
| 3 | RA 3 | 6.2 | 0.25 | 10.22 | 0.29 | 2.13 | 3.68 |
| 4 | UTZ 1 | 5.96 | 0.29 | 6.92 | 0.37 | 2.13 | 3.68 |
| 5 | UTZ 2 | 5.93 | 0.38 | 7.27 | 0.49 | 2.07 | 3.58 |
| 6 | UTZ 3 | 5.83 | 0.28 | 6.52 | 0.37 | 3.21 | 3.82 |
| 7 | Conv. 1 | 6.12 | 0.09 | 2.68 | 0.28 | 2.15 | 1.01 |
| 8 | Conv. 2 | 6.28 | 0.21 | 1.37 | 0.03 | 1.01 | 1.05 |
| 9 | Conv. 3 | 6.28 | 0.14 | 0.96 | 0.18 | 2.15 | 0.71 |

**MOADASO COMMUNITY**

| NUMBER | SAMPLE ID | pH | % TOTAL N | AVAIL P (mg/kg) | K (cmol/kg | % O.C. | %O.M. |
|---|---|---|---|---|---|---|---|
| 1 | RA1 | 6.12 | 0.26 | 5.86 | 1.01 | 2.41 | 3.47 |
| 2 | RA 2 | 5.85 | 0.24 | 6.51 | 0.54 | 2.71 | 2.96 |
| 3 | RA 3 | 5.21 | 0.21 | 4.41 | 0.75 | 2.13 | 3.68 |
| 4 | UTZ 1 | 5.48 | 0.31 | 7.96 | 0.41 | 1.72 | 3.96 |
| 5 | UTZ 2 | 5.76 | 0.29 | 5.96 | 0.39 | 2.13 | 3.68 |
| 6 | UTZ 3 | 6.42 | 0.27 | 6.25 | 0.34 | 1.98 | 3.4 |
| 7 | Conv. 1 | 5.34 | 0.16 | 3.08 | 0.23 | 0.23 | 0.85 |
| 8 | Conv. 2 | 6.5 | 0.21 | 3.16 | 0.11 | 1.08 | 1.02 |
| 9 | Conv. 3 | 5.9 | 0.11 | 2.08 | 0.13 | 1.06 | 1.17 |

**Appendix B. Analysis of Variance (ANOVA) Table – Soil Chemical Analysis**

Variate: %O_M

| Source of variation | d.f. | s.s. | m.s. | v.r | F pr. |
|---|---|---|---|---|---|
| Block stratum | 4 | 0.1810 | 0.0452 | 0.39 | |
| Treatment | 8 | 56.8950 | 7.1119 | 61.76 | <0.001 |
| Residual | 32 | 3.6846 | 0.1151 | | |
| Total | 44 | 60.7606 | | | |

l.s.d. (0.05) = 0.437 CV (%) = 2.7

Variate: %_O_C

| Source of variation | d.f. | s.s. | m.s. | v.r | F pr. |
|---|---|---|---|---|---|
| Block stratum | 4 | 1.3828 | 0.3457 | 1.20 | |
| Treatment | 8 | 19.7983 | 2.4748 | 8.59 | <0.001 |
| Residual | 32 | 9.2215 | 0.2882 | | |
| Total | 44 | 30.4025 | | | |

l.s.d. (0.05) = 0.692 CV (%) = 10.3

Variate: %_TOTAL_N

| Source of variation | d.f. | s.s. | m.s. | v.r | F pr. |
|---|---|---|---|---|---|
| Block stratum | 4 | 0.041458 | 0.01036 | 3.24 | |
| Treatment | 8 | 0.014391 | 0.00160 | 0.56 | <0.800 |
| Residual | 32 | 0.102342 | 0.00320 | | |
| Total | 44 | 0.158191 | | | |

l.s.d. (0.05) = 0.07285 CV (%) = 15.5

Variate: Avail P mg/kg

| Source of variation | d.f. | s.s. | m.s. | v.r | F pr. |
|---|---|---|---|---|---|
| Block stratum | 4 | 252.75 | 63.19 | 4.55 | |
| Treatment | 8 | 397.37 | 49.67 | 3.58 | <0.005 |
| Residual | 32 | 444.42 | 13.89 | | |
| Total | 44 | 1094.54 | | | |

l.s.d. (0.05) = 4.801 CV (%) = 40.8

Variate: K_cmol$^+$/kg

| Source of variation | d.f. | s.s. | m.s. | v.r | F pr. |
|---|---|---|---|---|---|
| Block stratum | 4 | 0.4146 | 0.1037 | 3.30 | |
| Treatment | 8 | 1.9627 | 0.2453 | 7.82 | <0.001 |
| Residual | 32 | 1.0042 | 0.0314 | | |
| Total | 44 | 3.3815 | | | |

l.s.d. (0.05) = 0.2282 CV (%) = 26.1

Variate pH

| Source of variation | d.f. | s.s. | m.s. | v.r | F pr. |
|---|---|---|---|---|---|
| Block stratum | 4 | 4.4375 | 1.1094 | 2.03 | |
| Treatment | 8 | 3.6885 | 0.4611 | 0.84 | <0.572 |
| Residual | 32 | 17.4796 | 0.5462 | | |
| Total | 44 | 25.6056 | | | |

l.s.d. (0.05) = 0.865 CV (%) = 1.4

**Appendix C: Socio-economic Sample Survey**

**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI**
**Department of Theoretical and Applied Biology**
**College of Sciece**
**M.Sc. Environmental Science**

***Topic: The Cocoa Certification Program and Its Effect on Sustainable Cocoa Production in Ghana: A Case Study In Upper Denkyira West District***

Dear Respondent:
I would like to request that you kindly spare part of your time to participate in this study that aimed at establishing the effect of the cocoa certification program on sustainable cocoa production in the Upper Denkyira West District of Ghana. The results will be used for Academic purpose only.

**SECTION A: DEMOGRAPHICS**

Date: ___/___ /20___
*Dd/mm/yy*

Name of Respondent: ____________________________________________

Gender: [ ] Male [ ] Female Age: _________ Contact No.: _________________

Marital Status: [ ] Married [ ] Divorce [ ] Widowed [ ]Single

Educational Level: [ ] MSLC/JHS [ ] SHS/O/A Level [ ] Tertiary [ ] No Formal Education

Community: ___________________________ Total Acreage: _________________________

Farmer Status: [ ] UTZ Farmer [ ] RA Farmer [ ] Conventional Farmer

Name of Enumerator: ____________________________________________

**SECTION B: CROP PROTCTION AND MANAGEMENT PRACTICE**

*The following statements relates to how weed is managed by cocoa farmers.*

1. Howdoes the farmer manage weeds on the farm?
   - By hand weeding [ ]
   - By weedicide [ ]
   - Both [ ]

2. If weedicide is used, what is the active ingredient?
   - Glyphosate [ ]
   - Paraquat [ ]

Atrazine [ ]

Other (**state the active ingredient**):___________________________________

*The following statements relates to how pest is controlled by cocoa farmers.*

3. Do you use insecticide to control capsids or mirids on your farm?

Yes [ ]

No [ ]

4. If YES, which of these insecticides do you used to control capsids or mirids?

Confidor (Imidacloprid) [ ]

Akate Master (Bifenthrin) [ ]

Actera 240 SC (Thiamethoxam) [ ]

Other (**states the name and the active ingredient**): ____________________________

5. How many times in a year do use pesticides to control capsids or mirids?

Once [ ]

Twice [ ]

Thrice [ ]

Other (**specify**): ______________________________________

6. Does the farmer keep records on the quantity of insecticides used?

Yes [ ]

No [ ]

7. What equipment do you use to apply the insecticides?

Mist blower [ ]

Knapsack [ ]

8.a. Do you use fungicides to control black pod disease of cocoa on your farm?

Yes [ ]

No [ ]

8.b. If **YES**, which of these fungicides do you used to control the black pod disease of cocoa?

Nordox Super (Cuprous oxide) [ ]

Ridomil Gold Plus (Metalaxyl-M + Cuprous oxide) [ ]

Champion (Copper Hydroxide) [ ]

Kocide (Cupric hydroxide) [ ]

Fungi-Kill (Copper +Metalaxyl) [ ]

Metalm (Metalaxyl +Copper oxide) [ ]

Agro-Comet (Metalaxyl +Copper (I) oxide) [ ]

Other (**states the active ingredient**): ______________________________________

9. How many times in a year do you use fungicides to control black pod disease of cocoa?

Once [ ]

Twice [ ]

Thrice [ ]

Other (**specify**):__________________________________________

10. What equipment do you use to apply the fungicides?

Mist blower [ ]

Knapsack [ ]

11.a. Do you use other methods to control black pod disease apart from the fungicides?

Yes [ ]

No [ ]

11.b. If **YES**, what methods? ______________________________________________________

12. Does the farmer keep records on the quantity of fungicides used?

Yes [ ]

No [ ]

**SECTION C: HEALTH AND SAFETY PRACTICES**

13. How is the agrochemical stored?

In agrochemical store [ ]

In bedroom [ ]

Kitchen [ ]

Other (**specify**): ___________________________________________

14. Do you use protective clothing for spraying or handling hazardous chemicals?

Yes [ ]

No [ ]

15. Do you have first-aid kits to respond to emergencies?

Yes [ ]

No [ ]

16. How many hours do you spent during spraying/application of agrochemicals?

Four [ ]

Five [ ]

Six [ ]

Other (**specify**):__________________________________________________

17. Have you receive any training on the use of agrochemicals from an extension officer?

Yes [ ]

No [ ]

18.a. Do you have stream, river or any water body around your farm?

Yes [ ]
No [ ]
Not Applicable [ ]

18.b. If **YES**, do you leave a buffer zone on your farm during spraying?

Yes [ ]
No [ ]
Not Applicable [ ]

19.a. Are you aware of the ideal time after which you can return to your farm after spraying of agrochemicals (re-entry time)?

Yes [ ]
No [ ]

19.b. Do you inform your community and family about re-entry time before you apply chemicals?

Yes [ ]
No [ ]

19.c.Do you use any danger sign to indicate re-entry time at the start, during and after spraying?

Yes [ ]
No [ ]

**SECTION D: CHILD LABOR CHARACTERISTICS ON THE FARM**

20.a. Do you have children below the age of 18?

Yes [ ]
No [ ]

20.b. If **YES**, do they go to school?

Yes [ ]
No [ ]
Not Applicable [ ]

21. Do these children help you on your farm?

Yes [ ]
No [ ]
Not Applicable [ ]

22. When do your children help you on your farm?

Weekends and holidays [ ]
Everyday [ ]
Not Applicable [ ]

23. Which type of activities does these children working or helping family farms perform?
Light and safe work [ ]
Handle and apply pesticides [ ]
Apply fertilizer [ ]
Carry heavy load [ ]
Use sharp farms tools such as machete [ ]
No work [ ]

24. Have you engage the services of children below the age of 18 years?
Yes [ ]
No [ ]

25.a. Do you have permanent workers working on your farm?
Yes [ ]
No [ ]

25.b. If **YES**, what is the age of the youngest worker on the farm? Specify: _____________years

**FARM REVENUE AND PROFIT MARGINS CHARACTERISTICS**

26.a Did you use **fertilizer** on your farm 2012/2013 season?
Yes [ ]
No [ ]

26.b If **YES,** which of these brand(s) of fertilizer did you use in 2012/2013 season?

| | | | |
|---|---|---|---|
| Asaase Wura | [ ] | Nitrabor | [ ] |
| Cocoafed | [ ] | No Application | [ ] |
| Sidalco | [ ] | Other (**specify**):________________ | |

26.c How many **bag(s)/liter(s)** of these fertilizer(s) did you use on your farm per acre in the ***2012/2013 season?***
Asaase Wura _________ bag(s)
Nitrabor_____________ bag(s)
Cocoafed ____________ bag(s)
Sidalco _____________ Litre(s)

No Application [ ]

Other (**specify**):________________

26.d What was the **unit price** of the fertilizer used on your farm for **2012/2013 season?**

Asaase Wura GH¢ _________

Nitrabor GH¢ _____________

Cocoafed GH¢ ___________

Sidalco GH¢ _________

No Application [ ]

Other (**specify**): GH¢ ________________



27.a Do you use **insecticide** to control capsids or mirids on your farm?

Yes **[ ]**

No **[ ]**

27.b If **YES**, which of these insecticides did you use to control capsids or mirids?

Confidor (Imidacloprid) **[ ]**

Akate Master (Bifenthrin) **[ ]**

Actera 240 SC (Thiamethoxam) **[ ]**

Other (**specify**):______________

No Application [ ]

27.c How many **ml** or **litre(s)** of these insecticide(s) per acre did you use for the ***2012/2013 season?***

Confidor (Imidacloprid (30mls type) ________ml(s)/acre

Confidor (Imidacloprid 1L type) ________L(s)/acre

Akate Master (Bifenthrin) ________ml(s)/acre

Actera 240 SC (Thiamethoxam) ________ml(s)/acre

No Application [ ]

27.d What was the **unit price** of the insecticide used on your farm?

Confidor (Imidacloprid (30mls type) GH¢ ________ml(s)/acre

Confidor (Imidacloprid 1L type) GH¢ ________L(s)/acre

Akate Master (Bifenthrin) GH¢ ________ml(s)/acre

Actera 240 SC (Thiamethoxam) GH¢ ________ml(s)/acre

No Application [ ]

**FARM INPUT – FUNGICIDES APPLICATION**

28.a Did you use **fungicides** to control black pod disease of cocoa on your farm?

Yes **[ ]**

No **[ ]**

28.b If **YES**, which of these fungicides did you use to control the black pod disease of cocoa for **2012/2013 season?**

Nordox Super (Cuprous oxide) [ ]

Ridomil Gold Plus (Metalaxyl-M + Cuprous oxide) [ ]

Champion (Copper Hydroxide) [ ]

Kocide (Cupric hydroxide) [ ]

Fungi-Kill (Copper +Metalaxyl) [ ]

Metalm (Metalaxyl +Copper oxide) [ ]

Agro-Comet (Metalaxyl +Copper (I) oxide) [ ]

Other (**states the active ingredient**): ___________________________________________

28.c How many **sachet(s)** of these fungicide(s) per acre did you use on your farm for **2012/2013 season?**

_______Nordox Super (Cuprous oxide)

_______Ridomil Gold Plus (Metalaxyl-M + Cuprous oxide)

_______Champion (Copper Hydroxide)

_______Kocide (Cupric hydroxide)

_______Fungi-Kill (Copper +Metalaxyl)

_______Metalm (Metalaxyl +Copper oxide)

_______Agro-Comet (Metalaxyl +Copper (I) oxide)

No Application **[ ]** Other (**specify**): ______________

28.d What was the **unit price** of the fertilizer used on your farm for **2012/2013 season?**

GH ¢_______Nordox Super (Cuprous oxide)

GH¢ _______Ridomil Gold Plus (Metalaxyl-M + Cuprous oxide)

GH¢ _______Champion (Copper Hydroxide)

GH¢ _______Kocide (Cupric hydroxide)

GH¢ _______Fungi-Kill (Copper +Metalaxyl)

GH¢ _______Metalm (Metalaxyl +Copper oxide)

GH¢ _______Agro-Comet (Metalaxyl +Copper (I) oxide)

No Application **[ ]** Other (**specify**): ______________

**CULTURAL MAINTENANCE – WEED & PRUNING MANAGEMENT**

29.a. How did you **manage** weeds on the farm for **2012/2013 season?**

By hand weeding [ ]
By weedicide [ ]
Hand weeding/weedicide [ ]

29.b. If weedicide was used, how many **litre(s)/bottle(s)** per acre for **2012/2013** season did you use**?**

Specify_______ bottles/litres
No Application [ ]

29.c. What was the **unit price** of the weedicide?

GH¢___________
No Application [ ]

30.a. If **hand** weeding, did you use **labourer**?

Yes [ ]
No [ ]

30.b. If **labourer** was used, how much did it **cost** you to weed an acre farm for **2012/2013 season?**

**Specify:** GH¢___________

30.c. How **many times** did you use labour to weed your farm last season?

Once [ ]
Twice [ ]
Thrice [ ]
Other (**specify**): _________

31.a. Did you **labour** to remove **mistletoe 'Nkranpan'** from your farm for **2012/2013 season?**

Yes [ ]
No [ ]

31.b. If **YES,** how much does it cost you to remove **mistletoe 'Nkranpan'** for **2012/2013 season?**

**Specify:** GH¢__________

32.a. Did you use **labour** to carry out **pruning** activities on your farm for **2012/2013 season?**

Yes [ ]
No [ ]

32.b. If **YES,** how much does it cost you for carrying **pruning** activities on your farm for **2012/2013 season?**

**Specify:** GH¢__________

**HARVESTING AND POST HARVEST COST**

33.a. Did you use **labour** for **harvesting** of cocoa?

Yes **[ ]**
No **[ ]**



33.b. If labour was used, how much did it **cost** to harvest an acre of cocoa farm?

**Specify:** GH¢__________

33.c. How many **times(s)** per year did use labour for harvesting of cocoa on your farm?

**Specify:** __________ time(s)

34.a. Did you use labour for **breaking** of **pods**?

Yes **[ ]**
No **[ ]**

34.b. If **YES,** how much does it cost you per for **breaking** of **pods** for **2012/2013 season?**

**Specify:** GH¢__________

34.c. How many times per year did you use labour for pod breaking for **2012/2013 season?**

**Specify:** __________time(s)

35.a. Did you use **labour** to **carry fermented** beans to the drying mat for **2012/2013 season?**

Yes **[ ]**
No **[ ]**

35.b. If **YES,** how much does it cost you per for **breaking** of **pods** for **2012/2013 season?**

**Specify:** GH¢__________

35.c. If **YES**, how much does it cost you for **carry fermented** beans to the drying mat for **2012/2013 season?**

**Specify:** __________time(s)

36.a. Did you use **labour** to **carry** dried beans to the sales point for **2012/2013 season?**

Yes [ ]
No [ ]

36.b. If **YES**, how much did it **cost** to carry **dried beans** from the acre farm to the **sales point**?
**Specify:** GH¢__________

36.c. How many **time(s)** per year do use labour for **carrying** dried beans to the sales point for **2012/2013 season?**
**Specify:** __________time(s)



**FARM REVENUE MARGINS**

37.a. How many **times** did you **harvest** cocoa from the acre farm for **2012/2013 season?**
**Specify:** __________ time(s)

37.b. What was the **yield(s)** per **harvest** per **acre** for **2012/2013 season**?
**Specify** the **weight** for each **harvest:**

1 ._______ kilo(s) 5. _______ kilo(s) 9. _______kilo(s)
2. _______kilo(s) 6. _______ kilo(s) 10. _______kilo(s)
3. _______kilo(s) 7. _______ kilo(s) 11._ ______kilo(s)
4. _______kilo(s) 8. _______kilo(s) 12._ ______kilo(s)
Other (specify). __________kilo(s)

38. How much **premium** or additional revenue did you receive from the sales of **certified beans** per bags?
**Specify:** GH¢__________ ***(To be answered by certified farmers only)***

**SHADE TREES MANAGEMENT**

39.a. Do you have **shade tree in** your farm?
Yes [ ]
No [ ]

39.b. If **YES,** how many **shade trees** per acre are on your farm?
**Specify the number:** ______________

39.c. If number present is **not up** to the **required number** (5 -9 trees/acre), do you have plans to increase the number to the required minimum per acre?

Yes [ ]

No [ ]

39.d If **YES,** how does the farmer intend to increase the required number of shade trees on the cocoa farm?

Supply from farmer organization/cooperative [ ]

Personal nursery [ ]

Allowing Native tree to grow [ ]

Other (**specify**): ____________________

39.e. Do you have **different** species or variety of shade tree present on the farm?

Yes [ ]

No [ ]