77589

SUPPLY CHAIN RISK ASSESSMENT

COCOA IN GHANA

THE WORLD BANK

CONTENTS

TABLES AND CHARTS

DISCLAIMER

ACKNOWLEDGEMENTS

This report was prepared by the Agricultural Risk Management Team of the Agricultural and Rural Development department of the World Bank. Financed by the European Commission's All ACP Agricultural Commodity Program (AAACP), the activity was conducted by a multidisciplinary team led by Vikas Choudhary and comprised of Roy Bateman, Stephen D'Alessandro, and Euan Mann. The team is grateful to Marc Sadler, Chris Jackson, and Jan Joost Nijhoff who reviewed the document and provided valuable guidance and support at various stages of the assessment process. The team would like to acknowledge the invaluable contributions provided by the Ghana Cocoa Board and the dedication of staff members Vincent Okyere Akomeah and Isaac Manu, both of whom were instrumental in providing support throughout. The team would also like to express their sincere gratitude to the stakeholders of the cocoa supply chain (farmers, cooperatives, exporters, traders, processors, non-governmental organizations(NGOs), and representatives of government organizations) who contributed their time, experience, and expertise during the assessment. The cover image was provided courtesy of Fairtrade Africa.

EXECUTIVE SUMMARY

Cocoa holds a unique position in Ghana's economy. It has long played a crucial role in Ghana's economic development and remains an important source of rural employment. It also remains the country's most important agricultural export crop. Among development priorities, the Government of Ghana (GoG) is committed to securing the future profitability and sustainability of the cocoa supply chain. To this end, following decades of declining output and stagnation, GoG has made sizable investments in restructuring the industry, improving productivity, and reducing marketing inefficiencies. It has set ambitious targets to raise output while maintaining its industry-leading quality standards. These initiatives have paid dividends in recent years, with significant gains in national output in the most recent decade along with surging export revenues. In 2009-10, Ghana exported more than half a million tons of cocoa beans, generating over US$1.6 billion in foreign exchange. Early indications suggest that cocoa purchases for the current year will fall just short of 1 million tons, securing the country's position as the world's second biggest producer of cocoa.

Amidst robust GoG support, current trends in the global market for cocoa and cocoa products suggest strong potential for further growth ahead. Yet, a number of risks threaten to derail the subsector's recovery. A deeper understanding of these risks and their existing potential to inflict damage and undermine growth is essential for the development of an appropriate risk management strategy. The purpose of this current study was to assist the Ghana Cocoa Board (COCOBOD) to: 1) gain a better understanding of which risks pose the greatest threat to Ghana's cocoa supply chain; 2) assess existing gaps in current risk management mechanisms; and 3) identify investments that would best serve to address those gaps.

The analysis highlights the extraordinary leadership that COCOBOD has demonstrated in tackling some of the most critical risks facing the sector. Nevertheless, the challenges are numerous and current levels of risk exposure facing stakeholders across the supply chain remain acute. This assessment identified the following five risks as posing the biggest threat to Ghana's cocoa subsector:

1. Black pod disease - Among production risks, black pod is both the most pervasive and costly to farmers. Notwithstanding current control measures, the average estimated value of annual crop losses stemming from black pod disease was more than US$300 million during the period 2008-10.
2. Mirids/capsids - Second only to black pod and the primary focus of COCOBOD's mass spraying program, mirids/capsids continue to inflict a heavy toll on Ghana's annual cocoa output. During the period 2008-2010, the average estimated value of annual crop losses due to mirid/capsid infestation was nearly $US172 million.
3. Swollen shoot - During the period 2007-10, outbreaks of swollen shoot affected more than 100,000 hectares across Ghana's cocoa production belt. First-year cumulative losses resulting from the felling of affected trees cost farmers an estimated US$84.9 million.
4. Cocoa price volatility - Among myriad market risks, the high volatility of cocoa prices on the open market remains the key challenge. Current risk management initiatives have been largely effective in shielding farmers and other stakeholders but, in turn, expose COCOBOD to a number of related risks, most notably, smuggling.
5. Smuggling - Illicit cross-border trade creates uncertainty over annual crop expectations, and thus, COCOBOD's ability to sell forward and manage price risk. It also leads to considerable losses in government receipts. During the period 2008-11, smuggling resulted in estimated financial losses to GoG and other stakeholders in the supply chain in excess of US$158.9 million.

Other threats such as drought, bushfires, loss of cocoa acreage, shifting market regulations, and counterparty risk, while notable, were deemed far less significant in terms of frequency and resulting value loss. Invasive species such as witches' broom and frosty pod rot, while not considered risks within the context of this assessment, nonetheless pose a noteworthy, existential threat to the cocoa supply chain in Ghana.

This assessment highlights the strong potential that exists for GoG and COCOBOD to build upon and further strengthen current risk management mechanisms in place. This can be best achieved via an evidenced-based reassessment, prioritization and reallocation of resources, and the development of a comprehensive roadmap encompassing the full range of available instruments, strategies, and policies. Among possible initiatives, this report makes the following recommendations:

- Improve efficacy of fungicide applications against black pod and reducing wastage via better fungicide application techniques and equipment (e.g. hydraulic sprayers, better nozzles).
- Develop mechanisms (breeding, grafting, pruning, etc.) to reduce cocoa trees to a manageable height throughout the country as tall trees inhibit pod monitoring and effective pest/disease management.
- Promote increased farm-level decision-making (vs. top-down) over black pod control measures and making use of private input supply networks to improve market availability of fungicides.
- Enhance operational-scale research into improved insecticide application techniques, with an emphasis on combining good spray coverage with minimal spray volumes.
- Develop mechanisms by which registered, non-CODAPEC insecticides can be distributed more easily via commercial suppliers.
- Focus swollen shoot control measures in the worst affected areas and ones with the best potential for yield improvement.
- Develop the ability to hedge futures independently in order to optimize their sales price and increase transparency and competition among international buyers.
- Utilize futures and potentially options to hedge a portion of forward sales to help minimize the Cocoa Marketing Company's (CMC's) direct counterparty exposure.
- Engage in a formal dialogue with the government of Cote d'Ivoire to identify collective responses and allocate additional resources along the border in order to restrict smuggling flows.

Given the importance of cocoa to Ghana's economic fabric and to the millions of Ghanaians who depend on it, it is hoped that this study will contribute to a better understanding among policy-makers, COCOBOD officials, and other stakeholders of the most important risks facing the domestic supply chain. It is also hoped that the findings of this report will help GoG and COCOBOD in the development of a comprehensive risk management strategy that will strengthen the sector's competitiveness while ensuring its profitability and long-term sustainability.

LIST OF ACRONYMS

Archer Daniels Midland	ADM
Agriculture and Rural Development	ARD
Agricultural Risk Management Team	ARMT
Bank of Ghana	BOG
Black Pod Disease	BPD
Centre for Tropical Agriculture	CIAT
Cocoa Marketing Company	CMC
Cocoa Pod Borer	CPB
Cocoa Processing Company	CPC
Cocoa Research Institute of Ghana	CRIG
Cocoa Swollen Shoot Virus Disease	CSSVD
Cocoa Swollen Shoot Virus Disease Control Unit	CSSVDCU
Ghana Cocoa Board	COCOBOD
Environmental Protection Agency	EPA
European Community	EC
European Union	EU
Export processing zones	EPZ
Food and Agriculture Organization	FAO
Foreign Direct Investment	FDI
Freight/Free on Board	FOB
Frosty Pod Rot	FPR
Ghana Cocoa, Coffee and Sheanut Farmers Association	GCCSFA
Government of Ghana	GoG
Gross Domestic Product	GDP
Integrated Pest Management	IPM
International Cocoa Organization	ICCO
International Food Policy Research	IFPRI
Kuapa Kokoo Farmers Union	KKFU

Licensed Buying Company	LBC
Metric Tons	MT
Ministry of Food and Agriculture	MoFA
National Cocoa Diseases and Pest Control	CODAPEC
Non-Governmental Organization	NGO
Produce Buying Company	PBC
Producer Price Review Committee	PPRC
Public-Private Partnership	PPP
Purchasing Clerk	PC
Quality Control Company	QCC
Sanitary and phyto-sanitary	SPS
Seed Production Unit	SPU
United Nations Human Settlements Programme	UN-HABITAT
West Africa Mills Company	WAMCO

1.0 INTRODUCTION

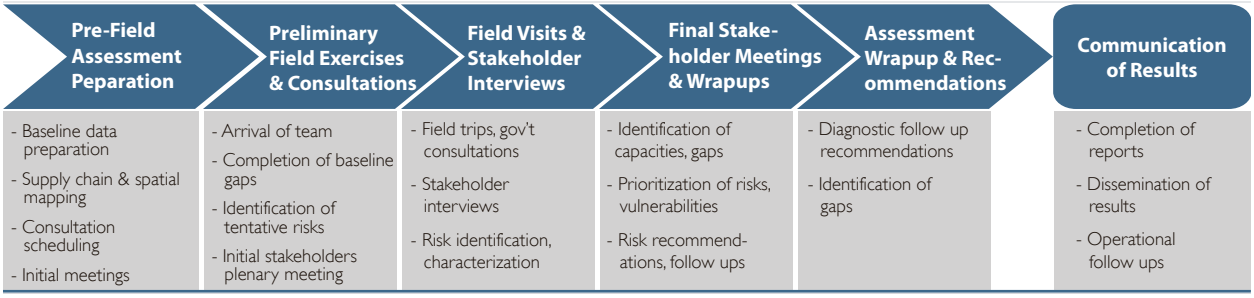
Cocoa is by far Ghana's most important crop. It dominates the agricultural sector and is a major source of income for approximately 800,000 farmers and many others engaged in trade, transportation, and processing of cocoa. Ghana's cocoa sector has staged an impressive recovery in recent years. Production has reached record highs of nearly 1 million metric tons. Farmers today receive a relatively large share of the Free on Board (FOB) price. Bean quality is world renowned and frequently exceeds the most stringent international standards. Exports are handled professionally and efficiently and international loans are repaid on time. Much of this success is due to the remarkable stewardship of the state-run marketing board, COCOBOD, which oversees nearly all aspects of the cocoa supply chain.

In April 1999, GoG approved a Cocoa Sector Development Strategy to guide the development of the cocoa industry following broad-based consultations with stakeholders. The strategy's overall vision was to create market conditions that would lead to broad-based rural growth and poverty reduction. The strategy featured the further restructuring of COCOBOD, accelerated increases in farmers' share of the FOB export price, and higher levels of private sector competition in domestic marketing. In efforts to sustain and build on recent growth, GoG is currently undertaking a comprehensive review of COCOBOD's operational policies and its sector development strategy. The result of this process will be a new 5-year growth plan, which it is hoped will promote the interest of all stakeholders and lead to a profitable, sustainable cocoa economy in the years ahead.

Within this context, and at the behest of the Government of Ghana (GoG) and COCOBOD, the World Bank conducted a supply chain risk assessment of the cocoa subsector in Ghana during May-June 2011. This report is the outcome of that assessment. The report: 1) identifies the major risks facing the cocoa supply chain; 2) ranks them in terms of their potential impact and frequency; and 3) offers a framework for improved risk management. The report is intended as an advisory note to help inform and guide ongoing strategic planning activities and follow-up planning work by the COCOBOD, GoG, and its development partners. Key policy issues identified in this assessment will also be articulated in the forthcoming Cocoa Sector Policy Brief currently being prepared by the World Bank.

The analysis presented in this report is based on a methodology for assessing risks in agricultural supply chains. The methodology was designed by the Agricultural Risk Management Team (ARMT) of the World Bank's Agriculture and Rural Development (ARD) department. It offers a conceptual framework and set of detailed guidelines for conducting a more system-wide assessment of risk, risk management, and vulnerability within agricultural supply chains. The following diagram (Figure 1.1) outlines the team's steps and the sequencing of activities during the assessment exercise.

FIGURE 1.1 - OUTLINE OF ASSESSMENT METHODOLOGY



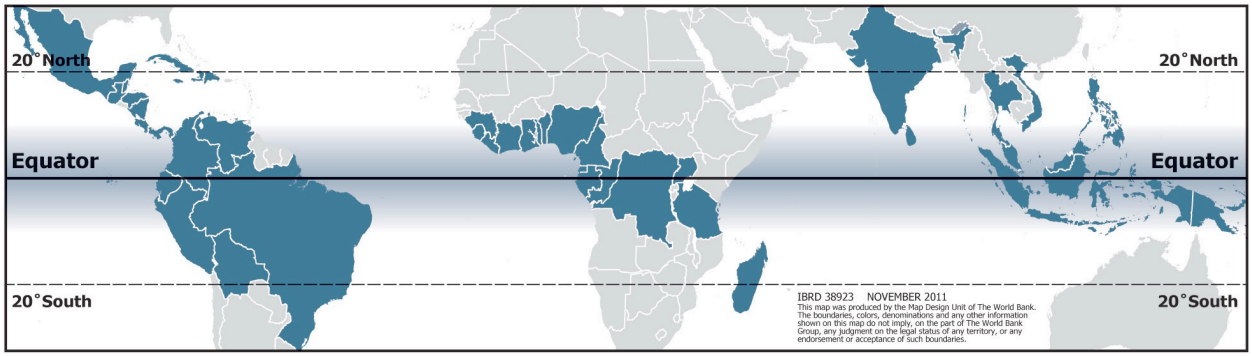
SOURCE: Rapid Agriculture Supply Chain Risk Assessment, The World Bank

Following initial analysis of baseline data and meetings with COCOBOD officials, the assessment team conducted in-depth interviews with key cocoa supply chain stakeholders in Accra and Tema and across the Western, Brong-Ahafo, Ashanti, and Eastern regions of Ghana's cocoa production belt. These included farmers, input suppliers, trading companies, domestic processors, service providers, government officials, NGO's and research institutes. A complete list of stakeholders interviewed is provided in Annex A7.

2.0 OVERVIEW OF THE COCOA SUBSECTOR IN GHANA

Cocoa is a tree crop that provides livelihoods for millions of smallholder farmers in over 50 countries across Africa, Latin America, the Caribbean and Asia. It grows best in humid, tropical zones located roughly 10 degrees north and south of the equator (Figure 2.1).

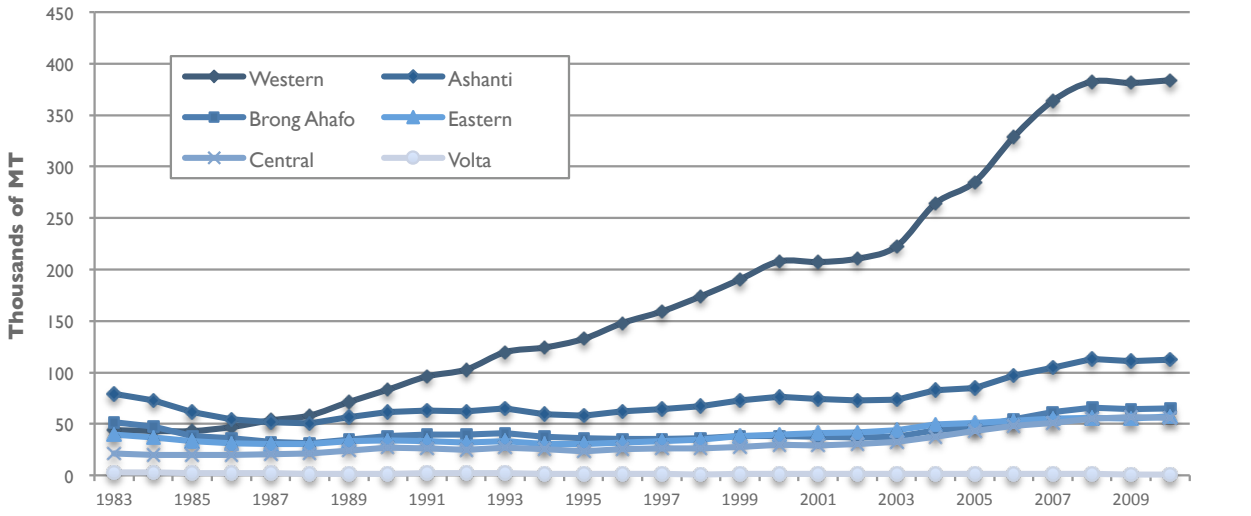
FIGURE 2.1 - COCOA PRODUCTION BELT



Global annual production has roughly doubled in recent decades, reaching 3.6 million tons in 2009-10 and increasingly concentrated in a handful of countries. Over the last 10 years, Africa has firmly established itself as the leading cocoa supplier. Since 2000/2001, Africa's production has expanded at an average annual rate of 2.7%, according to the International Cocoa Organization (ICCO, 2010). Much of this growth has come from Ghana, which achieved the largest increase in output (up by 269,000 tons). Farmers across West and Central Africa's cocoa belt now account for more than two-thirds of global production. The ICCO forecasts that annual global production will reach 4.5 million tons by 2013, growth which it expects will be primarily driven by West Africa (ICCO 2008). In 2009-10, Ghana was the second biggest producer after Cote d'Ivoire, representing 21% of global production (World Cocoa Foundation, 2010).

The importance of cocoa to Ghana's economy cannot be overstated. According to the Bank of Ghana, the sector accounts for more than 9% of agricultural Gross Domestic Product (GDP). Cocoa production supports the livelihoods of more than 800,000 smallholder households (Anim-Kwapong and Frimpong, 2004) and many others who depend on it for a significant share of their income.

FIGURE 2.2 - COCOA PRODUCTION BY REGION, 1983-2010*

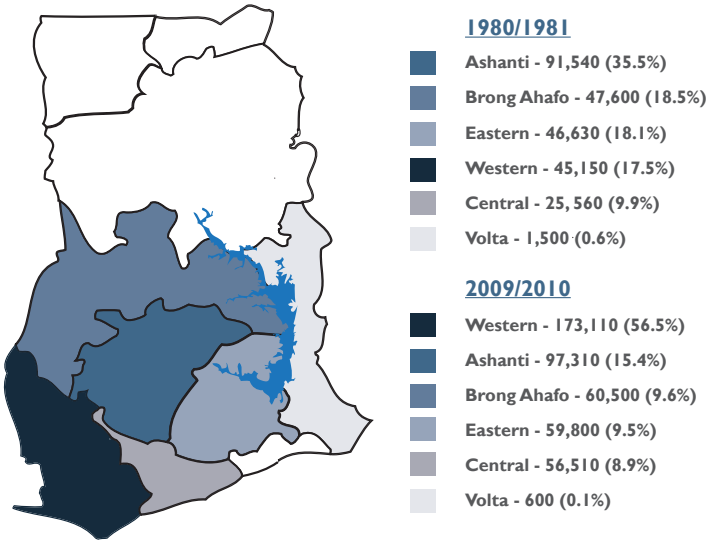


SOURCE: COCOBOD, 2011
* Based on 5-year rolling averages

Cocoa production in Ghana is focused nearly exclusively in the forest agro-ecological zones of the country—Ashanti Region, Brong-Ahafo Region, Central Region, Eastern Region, Western Region, and Volta Region—where climatic conditions are ideal for cocoa production. Figure 2.2 compares cocoa output trends by region.

The earliest cocoa farms were largely established in the southeast. Ever since, the epicenter of production has gradually shifted to the west. By the early 1980s, the Ashanti Region and Brong Ahafo Region accounted for 35.5% and 18.5%, respectively, of total output. Today, the Western Region alone supplies more than half (56.5%) of the total annual cocoa crop (Figure 2.3).

FIGURE 2.3 - COCOA PRODUCTION BY REGION, 1980/81 vs. 2009/10



SOURCE: COCOBOD

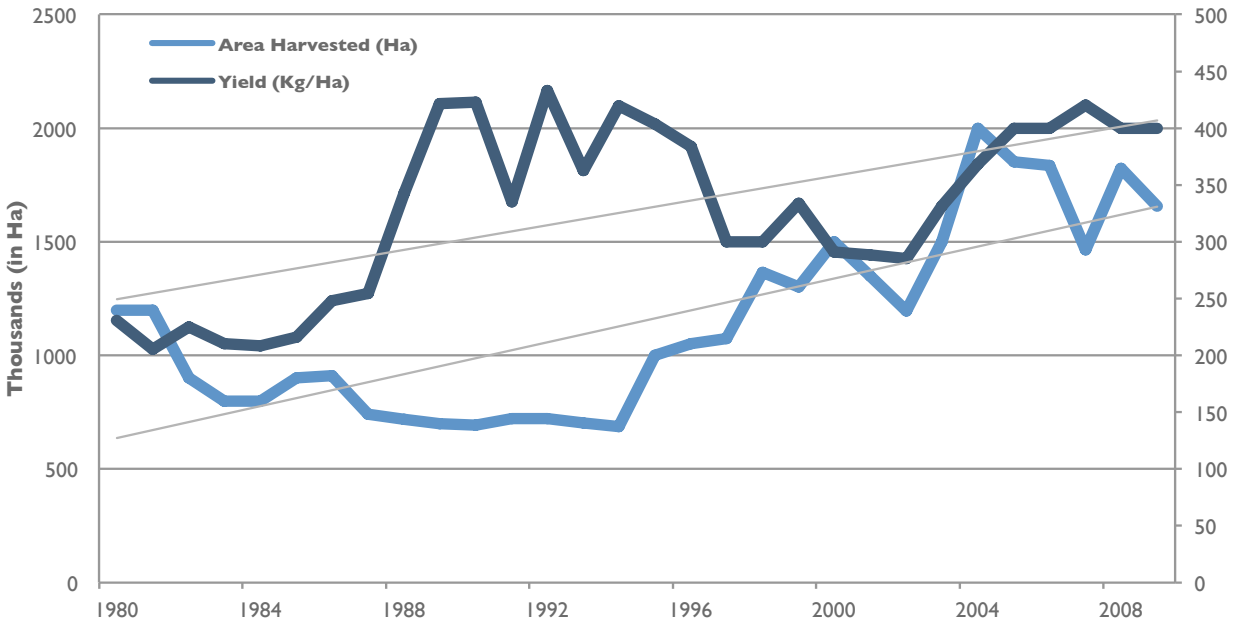
There are several drivers behind this gradual westward shift. First, the areas most suitable for cocoa production in Ghana are largely limited to the high rainfall, forested zones that stretch across the country's southern coastal interior. Secondly, farmers historically found it much easier to abandon their farms when their trees had gone beyond their productive lifecycle in favor of clearing new, virgin forest areas. Until recently, the country's western regions beckoned new and migrating farmers with ample land that offered ideal conditions for cocoa production. This practice discouraged intensive farming while contributing to deforestation and loss of biodiversity. Indeed, gains in productivity, until recently, were largely the result of land expansion rather than improved crop management or fertilizer use (Figure 2.4). However, well enforced regulations against forest encroachment, improved extension, and generous incentives to assist and encourage farmers to rehabilitate existing cocoa farms have helped to stymie, and in some areas, reverse this trend in recent years. In some areas, productivity gains have been substantial.[1]

Concerns over low productivity and environmental impacts have long fueled uncertainty over the sector's long-term sustainability (Gockowski, 2007; Vigneri, 2007). Indeed, Ghana's average annual cocoa yield over the last 30 years (330 kg/ha) is among the lowest in the world and compares unfavorably to leading producers such as Cote d'Ivoire (580 kg/ha) and Indonesia (770 kg/ha). Low productivity translates to low incomes for cocoa farming households. According to a recent survey of 3000 cocoa farmer households across Ghana, the mean annual average household income is 716 Ghanaian Cedi

[1] Since 1999, the Cocoa Research Institute of Ghana (CRIG) in partnership with Wienco Ghana Ltd. have promoted farmer adoption of the 'Abrabopa' package, a combination of agro-inputs and farm management practices, that has been shown effective in doubling and even tripling yields.

(Hainmueller, Hiscox, Tampe, 2011). Low incomes, in turn, impede growth and threaten the sector's long-term sustainability as farmers are discouraged from making productivity enhancing investments, including the use of fertilizers and pesticides.

FIGURE 2.4 - TOTAL COCOA AREA vs. YIELD TRENDS, 1980-2009



SOURCE: FAOSTAT, 2011

Beyond poor yields, low incomes, and land pressures, there are a number of other constraints to sector growth (see Annex A4). These include limited farmer access to credit, poor availability of affordable and timely inputs, weak organizational capacity of farmers (linked to low literacy rates), and a lack of technical extension support. While such constraints are not exclusive to the cocoa sector, they do serve to weaken farmers' and other stakeholders' ability to manage their exposure to risk as well as exacerbate the impact of risk events when they occur.

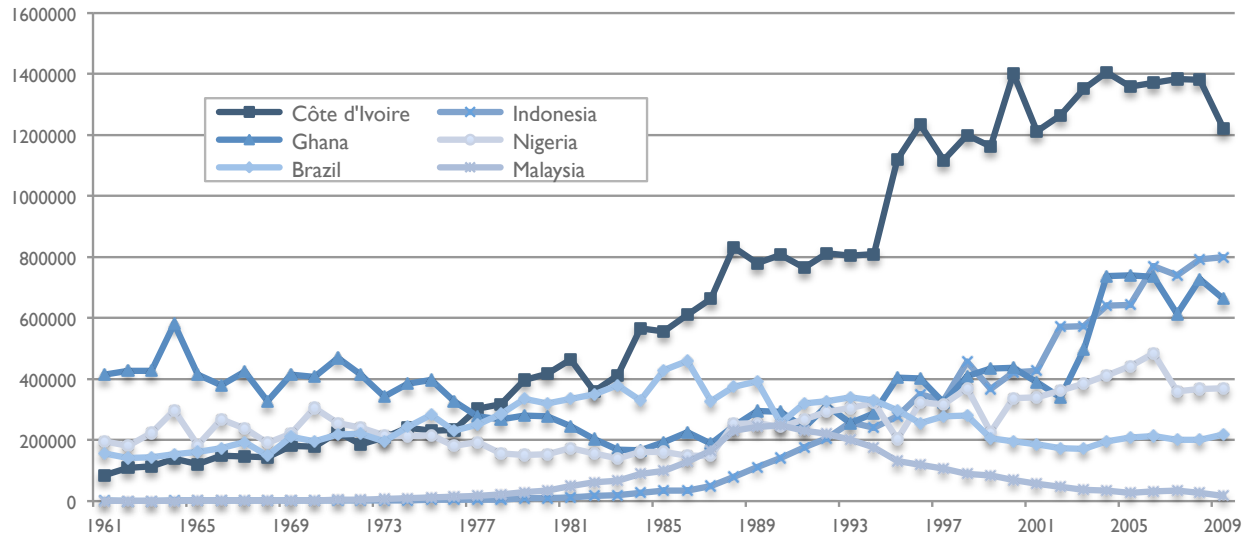
Despite these and other challenges, the sector has rebounded in recent years. Economic reforms since 1983 have played a major role in creating the right conditions for agricultural investments. Cocoa, in particular, has experienced notable growth, especially since 2000. Production now exceeds levels not seen in more than 40 years. Higher producer prices, partial liberalization of internal marketing, the establishment of a price stabilization system, and increased public spending on infrastructure and productivity-enhancing innovations (e.g., rehabilitation, mass spraying, fertilizer credits, improved extension, privatization of input distribution) have all likely played a role in the sector's recovery.

Following decades of decline that saw national production drop from nearly 600,000 metric tons (MT) in 1965-66 to a low of 166,700 MT in 1983-84 when severe drought and wildfires resulted in significant losses, Ghana has regained its top position among the world's leading cocoa producers (Figure 2.5). In 2009-10 Ghana's output exceeded 632,000 MT, according to COCOBOD figures. Early indications from this past year's crop suggest that Ghana will likely achieve its production target of one million MT by 2012-13.

Along with production, exports and associated foreign exchange earnings have been on the rise (Figure 2.6). Of the 632,000 MT produced in 2009-10, Ghana exported more than half a million (566, 700) MT of cocoa beans to more than 25 destinations worldwide. According to the ICCO, this makes Ghana one of the biggest supplier of cocoa beans, second only to Cote d'Ivoire. These exports generated over US$1.66 billion in revenues and represented nearly 21% of total merchandise exports (Bank of Ghana, 2011).

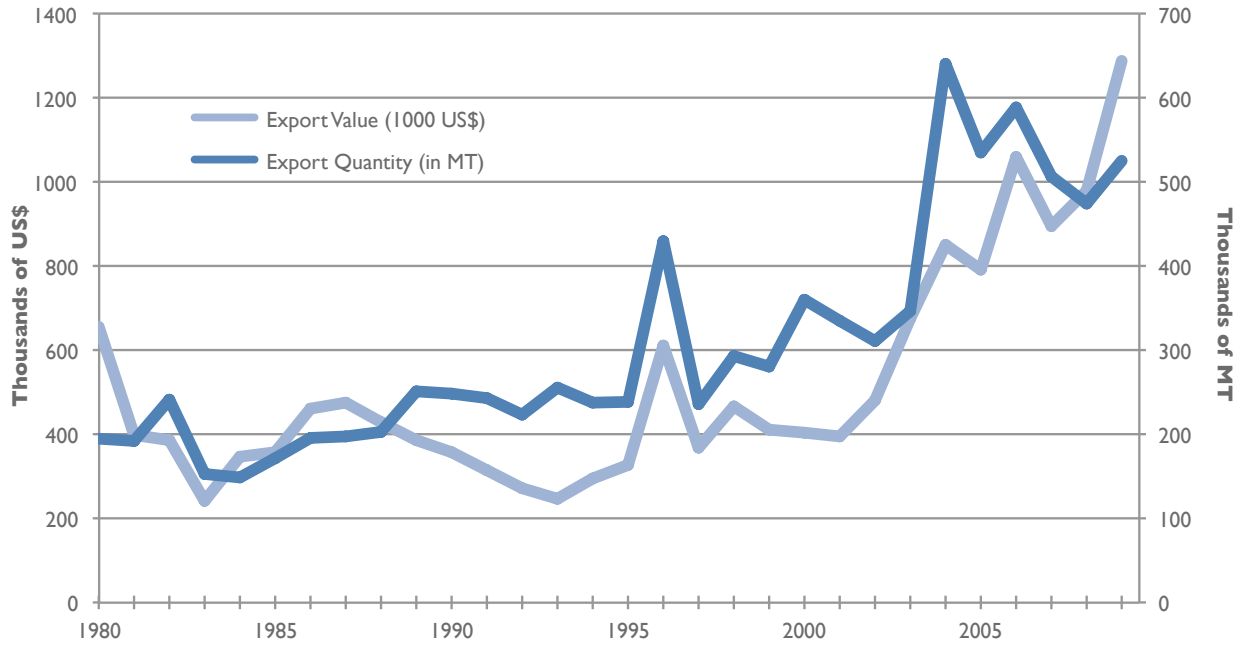
During the 5 month period October 2010-February 2011, Ghana exported nearly 328,000 MT of cocoa with an FOB value of nearly US$1.1 billion.

FIGURE 2.5 - TOP COCOA PRODUCERS, 1961-2009



SOURCE: FAOSTAT, 2011

FIGURE 2.6 - GHANA COCOA EXPORTS, 1980-2009



SOURCE: FAOSTAT; COCOBOD

Cocoa that is not exported is sold in the local market to be transformed into semi-processed and confectionary cocoa products. Fueled by foreign direct investment (FDI) inflows, Ghana's domestic processing sector has mushroomed in recent years. Grinding capacity has nearly tripled and is on track to reach a half million MT by 2012 with new investments in the pipeline.

In analyzing Ghana's notable success in attracting FDI into its processing sector, three factors emerge. First, Ghana has been able to solidify its reputation as a reliable supplier of top quality cocoa, all while achieving a more than twofold increase in production. This has been achieved through targeted investments in: 1) improved pest and disease management control; 2) replanting and rehabilitation; 3) better tree husbandry; and 4) increased use of fertilizers. Secondly, GoG has offered an aggressive package of incentives to investors including price discounts, extended payment credit, and special zones related tax breaks. Thirdly, upgrades to Ghana's infrastructure, including the country's two primary ports at Tema and Takoradi, have vastly improved the enabling environment for trade and private sector growth by reducing transaction costs and increasing market access.

It is likely that cocoa can and will continue to play an important role in Ghana's economic growth. First, international cocoa prices are likely to remain buoyant for the foreseeable future amid growing global demand for cocoa products, particularly in emerging markets. Second, cocoa yields in Ghana (as noted earlier) are well below international averages, suggesting strong potential for productivity-driven growth in the years ahead. Most importantly, GoG recognizes the importance of cocoa to its economy and is likely to maintain its strong support to the subsector.

3.0 ORGANIZATIONAL STRUCTURE OF THE COCOA SUPPLY CHAIN

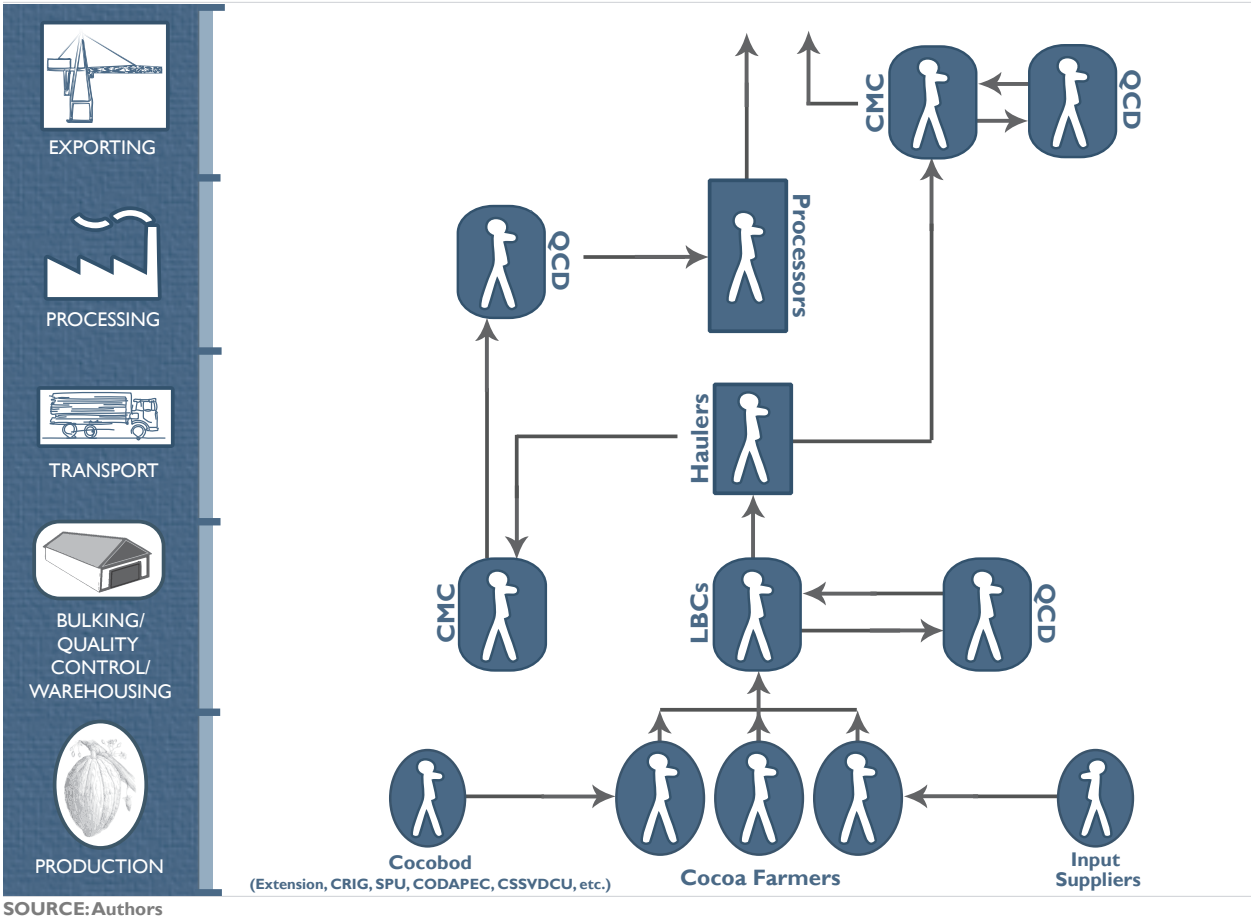
This section presents an overview of the organizational structure of the cocoa supply chain in Ghana. It identifies and profiles the key actors and describes their specific roles within the supply chain. It explores the interrelationships between actors and the principal factors that influence behavior and drive decision-making. It highlights some of the major challenges that each actor faces and identifies some of the strategies they use to overcome them.

Overall, the cocoa supply chain can be subdivided along four major product categories, based on the stage of processing. Each is subject to specific challenges and risks. These categories are the following:

1. Cocoa beans (raw, or minimally processed);
2. Semi-finished cocoa products (cocoa paste/liquor, cocoa butter, cocoa powder);
3. Couverture, or industrial chocolate;
4. Finished chocolate confectionary products.

The current assessment focuses on Ghana's domestic supply chain, which encompasses the production and marketing of cocoa beans and semi-finished cocoa products from their origin up to the point of export. Assessing risks that pose a potential threat to the downstream supply chain beyond Ghana's borders is beyond the scope of this study. Figure 3.1 offers a graphic illustration of the cocoa supply chain in Ghana. As illustrated, the supply chain is comprised of a wide range of actors, from input suppliers to farmers, to traders, to transport and other service providers, to processors. Each has a fundamental role to play in the supply chain that brings cocoa and cocoa products to the market.

FIGURE 3.1 - COCOA SUPPLY CHAIN MAP IN GHANA



SOURCE: Authors

3.1 Ghana Cocoa Board

The cocoa supply chain in Ghana is best characterized by its unique marketing arrangement. It combines elements of privatization with a strong government presence. The Ghana Cocoa Board Head Office and its divisions regulate the activities of all other stakeholders in the industry. The cocoa marketing process begins with the farmers and ends with government export, with COCOBOD overseeing each step along the way.

Ghana remains the only major cocoa producing country in the world without a fully liberalized marketing system. Since the early 1990s, GoG opted for a gradual introduction of reforms, which thus far have encompassed the partial liberalization of internal marketing, privatization of input distribution, and restructuring of extension services. As such, COCOBOD still plays a major role in external marketing and quality control. COCOBOD retains a portion of the FOB price to cover operating expenses and to reinvest in the cocoa economy in the form of, *inter alia*, farmer bonuses, educational scholarships, input supply subsidies, research, and the improvement of road networks.

COCOBOD's policies are implemented through the following specialized divisions:

3.1.1 Cocoa Swollen Shoot Virus Disease Control Unit (CSSVDCU)

CSSVDCU is responsible for the survey and control of the Cocoa Swollen Shoot Virus Disease (CSSVD). The unit's activities include the removal and destruction of diseased cocoa trees from farms and supply of disease-tolerant hybrids (pod and saplings) for replanting.

3.1.2 Seed Production Unit (SPU)

SPU is responsible for the multiplication and distribution of improved cocoa (and coffee) planting materials to farmers. SPU maintains seed gardens at 23 cocoa stations in the seven cocoa-growing regions. The Unit multiplies high-yielding, early-bearing hybrid cocoa types and distributes them to farmers as seed pods and saplings at a subsidized cost. The Unit produces about 3 million hybrid pods and raises about 2 million cocoa seedlings per annum.

3.1.3 National Cocoa Diseases and Pest Control (CODAPEC)

The CODAPEC program, popularly known as "Mass Spraying," was reintroduced in the 2001/02 cocoa season to assist cocoa farmers across Ghana to combat cocoa mirids and black pod diseases. CODAPEC's other objectives include: 1) training farmers and technical personnel on the cultural and chemical methods of pests and diseases control; and 2) educating and training local sprayers on safe pesticides usage. District and local task forces carry out CODAPEC's mandate and coordinate the spraying programs. Currently, 67 cocoa districts covering all of Ghana's major cocoa growing areas are benefiting from the program. This includes 21 districts being treated exclusively for black pod disease; 35 districts being treated exclusively for mirids; and 16 districts covered for both.

3.1.4 Cocoa Research Institute of Ghana (CRIG)

Established in 1938, CRIG has established itself as a center of excellence in the study and cultivation of cocoa. Its mandate is to undertake research into challenges relating to the production, processing and utilization of cocoa and other tree species. Its activities include: 1) providing cocoa farmers with technical innovations that improve yields; 2) identifying new processing techniques and marketable consumer products and by-products; and 3) ensuring effective transfer of research findings, new technologies, and agronomic practices to farmers.

3.1.5 Quality Control Company (QCC)

QCC is responsible for maintaining quality standards and overseas quality control measures at all stages of the supply chain. These measures include: 1) inspection and certification of the licensed buying companies (LBC) depots where cocoa is bulked and stored; 2) grading, sealing and certifying of cocoa at the LBC depots; 3) sampling of cocoa on arrival at port warehouses (located at Kaase, Tema, and Takoradi) and prior to export to determine whether a particular consignment meets local and

international standards; 4) inspection and fumigation of storage sheds, warehouses and shipping vessels and all cocoa consignments prior to shipment; and 5) promotion and sensitization of farmers through training of optimal pre- and post-harvest practices required to maintain quality standards. QCC has staff operating in all the 67 cocoa districts located in the seven cocoa regions and at the three takeover centers.

3.1.6 Cocoa Marketing Company Limited (CMC)

Located in Accra with a satellite office in London, CMC is a wholly-owned subsidiary of COCOBOD with the sole responsibility to market and export Ghana cocoa beans to local and foreign buyers. Its major responsibilities include: 1) procurement of graded and sealed cocoa beans from the LBCs at the three takeover centers; 2) stocking of cocoa prior to shipment; 3) securing optimal prices and maximizing foreign exchange revenue; 4) managing sales and collecting receipts; and 5) settling of any disputes via direct arbitration.

3.2 Cocoa Farmers

Like elsewhere, smallholder farmers in Ghana are the backbone of the cocoa supply chain. Their primary activity is year-round production of cocoa, an activity that supports the entire supply chain, upon which millions of Ghanaians depend for income. According to COCOBOD estimates, there are approximately 800,000 cocoa producing households. The vast majority cultivate cocoa on smallholdings averaging two to three hectares. According to a recent survey of cocoa households, more than three-fourths (76%) claim to own their land. Among these, 38% actually hold legal title to their land (Hainmueller et al., 2011). An estimated 20% of cocoa farmers in Ghana are sharecroppers.

3.3 Input Suppliers

Input supply in Ghana is for the most part in the hands of the private sector. However, GoG through COCOBOD retains an active role through subsidized input distribution programs targeting cocoa farmers, although farmers bear the bulk of the cost, in line with its strategy to raise productivity and output (see Annex A4). Input suppliers, in general, cater to the needs of farmers via the marketing of fertilizers, insecticides and other agrochemicals, and farm equipment and tools. With few exceptions, the vast majority are small-scale suppliers who operate at the local level on an informal or semiformal basis. While many are independent, some operate as licensed distributors for larger wholesale imports or manufacturers. They typically source products on a cash or limited credit basis from wholesalers based in Kumasi or Accra for localized resale.

Among input suppliers interviewed for this study, few reported keeping a regular stock of cocoa-related inputs, equipment and other supplies. Some expressed concerns over the government's subsidy program on fertilizers, which made it difficult for them to compete with open market-priced alternatives. Others expressed confusion over regulations that banned the sale of certain products, referring to insecticides and fungicides used in COCOBOD's mass spraying programs. These products are specially packaged for COCOBOD and labeled "not-for-sale." Nonetheless, considerable quantities are said to end up in the black market.[2] Other input suppliers cited limited sales among cash-strapped cocoa farmers as the reason they chose not to stock more cocoa-related inputs. Generally, input suppliers sell their products nearly exclusively on a cash-and-carry basis, viewing cocoa farmers in particular as a high credit risk. Few input suppliers offer training or after sales support related to the products they sell.

[2] Based on anecdotal evidence, CODAPEC fungicides and insecticides have been found in local markets across Nigeria and Cameroon, where "Not for Sale" has become an attractive mark of quality.

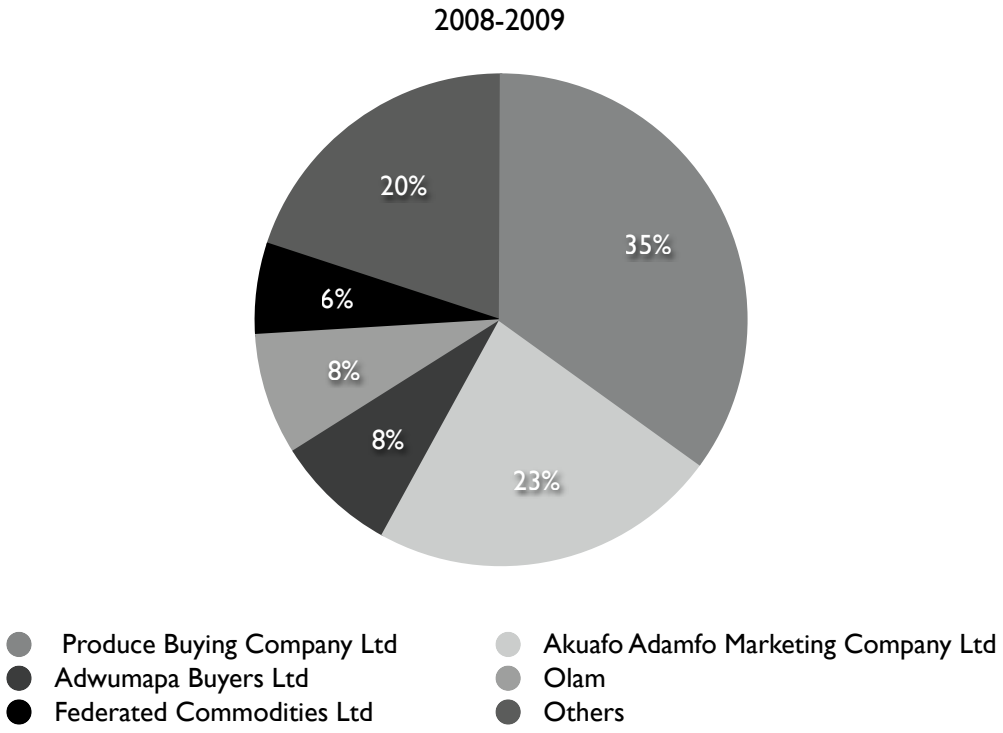
3.4 Licensed Buying Companies

Farmers sell their cocoa to Licensed Buying Companies (LBCs). Regulated by COCOBOD, these privately owned and operated businesses are responsible for purchasing the cocoa at farmgate at a guaranteed floor price (i.e., the 'producer price') and for transporting it to one of three takeover points to sell at a fixed price to COCOBOD for export. They also share responsibility in delivering only cocoa that meets COCOBOD's stringent quality standards. Strict rules govern their buying activities. LBCs are required to grade the beans for size and quality. They are also required to ensure that the beans have been properly dried after fermentation. Once the bag is sealed, the cocoa remains in the custody of the buyer until it is takenover by COCOBOD.

LBCs' revenues are based on volumes of cocoa marketed. Since LBCs face a floor price for farmers and a fixed sale price from COCOBOD, they effectively receive a set amount of revenue per quantity of cocoa delivered. Under this system, LBCs seek to maximize their profits by maximizing the bean volumes they purchase while minimizing 'turnaround' times, or the period from the purchase of the beans at farmgate to the selling of the beans at the takeover centers. At the start of the buying season, each LBC receives a subsidized rate-loan based on their market share from COCOBOD to be used exclusively for cocoa marketing purposes.

The number of registered LBCs has been steadily growing since domestic marketing was opened up to competition beginning in the early 1990s. Today, there are 28 registered LBCs. Figure 3.2 illustrates the percentage of market share among them based on their purchases in 2009/10. The market share of Produce Buying Company (PBC), erstwhile subsidiary of COCOBOD, has fallen substantially over the past two decades. Nonetheless, PBC remains the largest buyer. It also acts as a buyer of 'last resort' since it has been mandated to procure cocoa even from low-production areas, which are often avoided by other LBCs due to cost and profit concerns.

FIGURE 3.2 - SHARE OF COCOA PURCHASES BY LBCs, 2008-2009



SOURCE: COCOBOD Annual Report,2009

Today, as a result of increasing competition most cocoa farmers have access to two or more LBC outlets, giving them a choice of buyers. This encourages LBC to offer incentives to gain access to farmers' cocoa and loyalty. Rather than by offering higher prices, LBCs typically compete through the provision of value-added services to farmers. This can sometimes take the form of credit, enabling liquidity-constrained farmers to invest in productive inputs. However, this practice is becoming increasingly rare among localized LBC buying clerks due to high default rates and associated losses.

3.4 Haulers

Private transport service companies are responsible for picking up cocoa consignments from LBCs located at the district levels and delivering QCC certified and sealed cocoa to one of the three primary takeover points (i.e., Tema port, Takoradi port, and the inland port at Kaase). For evacuating the cocoa, hauliers receive payments based on fixed rates determined by the Producer Price Review Committee (PPRC). The PPRC's annual meeting determines how resources will be allocated and fixes new prices, fees, and rates for the coming season (see Annex 1).

3.5 Domestic Processors

The annual installed grinding capacity increased from 110,000 MT in the early 2000s to approximately 370,000 MT currently (Table 3.3), shared among eight cocoa processors. Their chief concern is securing a reliable supply of affordable, quality cocoa, free of hazardous substances. All rely on COCOBOD to supply them with cocoa beans to support their domestic processing activities. Growing competition for low-grade, discounted beans[3] has been on the rise amid declining availability; this is partly a result of quality-enhancing on-farm investments such as better tree husbandry and increased fertilizer use.

In 2008-2009, COCOBOD delivered 129,074 MT of both discounted and non-discounted cocoa beans to seven processing companies: namely, WAMCO, Barry Callebaut, CPC, Commodity Processing Industries Ltd, Plot Enterprise, Cargill Ghana Ltd. and ADM Ltd.[4] Table 3.3 shows each company's share of cocoa bean purchases. In the same year, they processed 50,933 tons of cocoa liquor, 22,944 tons of coca butter, 19,180 tons of cocoa cake and 5,054 tons of cocoa powder.

TABLE 3.3 - DOMESTIC GRINDING CAPACITY

COMPANY	INSTALLED CAPACITY (in MT)	SHARE OF COCOA PURCHASES, 2008/09 (%)
WAMCO	80,000	11%
Cargill Ghana Ltd.	65,000	33%
Barry Callebaut	65,000	31%
CPC	64,500	8%
ADM	35,000	15%
Plot Enterprises	32,000	1%
Commodities Processing Industries Ltd.	15,350	1%
Afrotropic Cocoa Processing Ltd (ACPL)	12,500	0%

SOURCE: Oxfam, 2009; news articles; COCOBOD Annual Reports; other industry sources

[3] Discounts are offered only on low-grade beans (ie., of bean-size count >101). CMC also supplies higher grade beans (i.e., ≤ 101) to processors at market price.

[4] See 40th Annual Report, Ghana Cocoa Board, September 2009.

4.0 MAJOR RISKS TO THE COCOA SUPPLY CHAIN

This section presents a discussion of the assessment's key findings. Table 4.1 summarizes the risks identified and groups them into three main categories: production risks, market risks, and enabling environment risks.

TABLE 4.1 - KEY RISKS TO THE COCOA SUPPLY CHAIN

PRODUCTION	MARKET	ENABLING ENVIRONMENT
• Black pod disease • Mirids/capsids • Swollen shoot virus • Other pests, diseases, and weeds • Drought/dry spell • Bushfires • Loss of cocoa acreage	• Cocoa price volatility • Exchange rate volatility • Counterparty risk • Input price volatility • Interest rate volatility	• Smuggling • Market regulatory risk • Policy risk • Logistics breakdown • Misappropriation of funds

In order to identify and analyze potential risks to the cocoa supply chain in Ghana, the assessment team undertook a comprehensive review of 20-30 years' time-series data related to production, marketing, climatic conditions, the macro-economic environment, etc. It also considered other events unrelated to the above that may have had an impact on sector growth. In addition, the team conducted field interviews to solicit input directly from key industry stakeholders.

The team then used the information collected to prioritize risks identified according to their frequency and relative potential to cause financial losses to various actors operating within the supply chain. The key risks identified are captured in Table 4.2. The risks located in the dark grey areas in the upper-right represent the most significant risks due to their potential to cause the greatest losses and their high probability that they will occur in the near-term. Conversely, risks found in the bottom-left corner have low potential to cause damages and are unlikely to occur in the foreseeable future.

TABLE 4.2 - RISK PRIORITIZATION

PROBABILITY OF EVENT	SEVERITY OF IMPACT: NEGLIGIBLE	MODERATE	CONSIDERABLE	CRITICAL	CATASTROPHIC
HIGHLY PROBABLE			• Mirids/capsids • Cocoa price volatility	• Black pod	
PROBABLE	• Cocoa acreage loss • Misappropriation of funds	• Exchange rate volatility • Other pests, diseases, weeds • Input price volatility • Counterparty risk (i.e., input suppliers, farmers, LBCs) • Logistics breakdown	• Smuggling	• Swollen shoot virus	
OCCASIONAL	• Interest rate volatility	• Drought/dry spell • Policy risk • Market regulation risk			
REMOTE		• Bushfires • Counterparty risk (i.e., CMC/buyers)			

4.1 PRODUCTION RISKS

The principal finding of this assessment is that crop diseases and insect pests pose by far the greatest risk to the cocoa supply chain in Ghana. Events such as drought and forest fires are only significant in exceptional years and have a negligible long-term impact on national cocoa production.

4.1.1 Black Pod Disease

Probability: Highly Probable
Severity: Critical

Black pod disease is nearly ubiquitous in cocoa growing areas. It is caused by a pathogen called *Phytophthora*, of which several species infect pods:

- *Phytophthora megakarya* is unique to Central and West Africa. It is thought to have originally infected cocoa from local forest trees and has been identified on the fruits of *Cola* and *Irvingia* species. Until 1985, it was unknown in Ghana. *P. megakarya* in some years causes widespread crop loss in West Africa: it may result in 85-95% yield losses if left untreated.
- *Phytophthora palmivora* has a worldwide distribution and is found in tropical and subtropical regions. It infects cocoa and over 200 other plant species.
- Other *Phytophthora* species may be a local concern to some cocoa growers in Ghana.

In Ghana and Cote d'Ivoire, black pod disease caused by *P. palmivora* is less pathogenic and can be largely controlled with regular phytosanitary procedures (i.e., removal of diseased pods, canopy management to reduce shade, etc.). Following the arrival of *P. megakarya,* these practices were insufficient to reduce losses. Fungicides are now widely used for control of the disease. The most widely used include a range of copper products and metalaxyl. Phenylamide compounds have protective, curative, and systemic[5] properties, whereas the older copper fungicides are only protective and must be applied liberally in order to be most effective.

Apart from certain farms that are severely infested with swollen shoot disease, the majority of farmers interviewed during consultations reported that black pod disease was the most important cause of crop loss. This was often evident during farm visits. As part of its program schedule (see Annex A6 for an overview of CODAPEC's operations), CODAPEC aims to apply three fungicide sprays per year. Nevertheless, it is widely recognized that six or more sprays are required for severe infestations.

TABLE 4.3 - CODAPEC ESTIMATES FOR BLACK POD INFESTATION

Year	Acreage Infested (in Ha, est.)	Acreage Sprayed (in Ha)	(*p*)+	Crop Loss* (in MT)	Price (US$/MT)	Loss/Gain (in US$)
2008	1,039,725	976,332	0.94	117,593	$2,104	$247,415,456
2009	1,113,503	1,020,432	0.92	125,937	$2,400	$302,249,254
2010	1,156,622	1,156,622	0.9	130,814	$2,702	$353,459,227

SOURCE: CODAPEC Annual Report, 2009/10; Authors' calculations
+ '*p*' is a gross estimate of the proportion of estimated hectarage infested in relation to hectares actually sprayed. Since multiple applications could (and should) take place, the value can be >1. The low values for black pod spraying suggest that considerable underdosage is taking place.
*Nominal potential loss @ 30% with an average yield of 377 kg/ha.

Table 4.3 shows that, on average, less than one spray was applied (*p*) over the last three years recorded. In addition, most farmers interviewed reported difficulties in obtaining fungicides (registered or otherwise). In addition, virtually no private input suppliers visited during this assessment had either

[5] Systemic pesticides are pesticides that are absorbed by plants or animals and move to untreated tissues.

copper fungicides or metalaxyl in stock. It is worth noting here that: 1) the severity of black pod disease can be patchy in both time and space, so mechanisms that maximize farmer decision-making on treatments are most appropriate; and 2) with a combination of very tall trees and inappropriate spraying equipment, spraying is highly inefficient, whether carried out by farmers or CODAPEC spray gangs.

Although it is difficult to quantify how much crop is lost from underdosage of fungicides, 30% is likely a conservative estimate when conditions are suitable for widespread infections of *P. megakarya*. In general, heavy rainfall and damp, humid conditions are highly conducive. The mechanisms of disease spread are complex and may differ among *Phytophthora* species. The spores are motile under wet conditions, but inoculum in infested soil may transfer to pods via rain splash or insects. Soils with high organic matter and good drainage help prevent inoculum splashing and spreading in puddles of water.

Factors such as quality and timing of application determine the efficacy of fungicide treatment. For example, with *P. megakarya*, in "typical" years there might be a high variation (50-99%) in crop loss if untreated. According to CRIG scientists interviewed for this study, "good" control can reduce crop loss to 10%. Skillful cultural control with multiple sprayings of well-applied protectant and eradicant fungicides could potentially reduce losses even further. The US$ values of potential gains cited above that could be captured via more effective control measures are merely suggestive. However, even with the most conservative estimate, the numbers are large enough to suggest that investment in more effective management of the black pod risk would achieve a very high benefit/cost ratio.

4.1.2 Cocoa Mirids/Capsids

Probability: Probable
Severity: Critical

Cocoa mirids (*Sahlbergella singularis* and *Distantiella theobromae*), also known as 'capsids', have been important pests of West African cocoa for over a century. Industry sources suggest that these insects cause annual crop losses in excess of an estimated 100,000 tons in Ghana. They are an example of 'new encounter' pests: local insects that adapted to a new food source when a non-indigenous crop (in this case, cocoa from the Amazon region of South America) was introduced to West Africa in the 19th century. Mirids damage cocoa trees by feeding on tree sap. They cause characteristic lesions on the surface of cocoa pods, and often introduce pathogenic fungi. Nonetheless, the greatest damage from mirids is to the tree itself. Mirid infestation typically leads to the destruction of growing shoots and, in severe cases, the loss of the tree.

Practical control measures include good tree maintenance (i.e., prevention of gaps in the canopy and removal of chupons) and applications of insecticides. Table 4.4 shows average numbers of spray applications (*p*) during the period 2008-10. In 2009 the ratio was 1.23. Given that two sprays is the recommended standard for effective control, CODAPEC is much nearer its operational target for mirids than with black pod disease.

TABLE 4.4 - CODAPEC ESTIMATES FOR MIRID/CAPSID INFESTATION

Year	Acreage Infested (in Ha, est.)	Acreage Sprayed (in Ha)	(*p*)+	Crop Loss* (in MT)	Price (US$/MT)	Loss/Gain (in US$)
2008	1,705,115	1,660,998	0.97	64,283	$2,104	$135,251,086
2009	1,708,815	2,106,929	1.23	64,442	$2,400	$154,613,581
2010	2,212,200	2,185,255	0.99	83,400	$2,702	$225,346,638

SOURCE: CODAPEC Annual Report, 2009/10

*Nominal potential loss @ 10% with an average yield of 377 kg/ha.

+ '*p*' is a gross estimate of the proportion of estimated hectarage infested in relation to hectares actually sprayed. Since multiple applications could (and should) take place, the value can be >1. While some infested areas get recommended doses of spraying, some receive less than optimal and some might not receive any spraying at all. The low values for spraying suggest that considerable underdosage is taking place.

There are a number of technical reasons for maintaining, preferably improving, COCOBOD-supported spray operations. These include: 1) provision of protective equipment, which is vital for insecticides that are typically more toxic than other pesticides; 2) spraying against mirids typically requires more general coverage of cocoa trees, which is best achieved using motorized mist-blowers rather than manual sprayers; 3) motorized mist-blowers are costly (typically $300-$500 per unit) and require special maintenance; and 4) mirid control teams have leverage to enforce good tree husbandry.

As with Table 4.3, the projections of potential crop loss and benefit/cost with improved mirid control are likewise rather conjectural. There is need to put in place improved application techniques to: 1) reduce the amounts of (increasingly expensive) insecticide used per hectare (CODAPEC distributed in excess of 2.1 million litres in 2010); and/or 2) increase the efficacy of sprays.

4.1.3 Swollen Shoot Virus Disease

Probability: Highly Probable
Severity: Considerable

Cocoa swollen shoot virus disease (CSSVD) is a plant pathogenic virus spread primarily by the mealybug. The virus is retained when the insect moults, but it does not replicate in the insect. Alternate hosts include red mistletoe (see below). The disease can also spread via roots and interlocking branches, thus necessitating the cutting of neighboring cocoa trees for effective control. Many strains of the virus exist, each varying in symptoms and virulence. Infected trees are infectious before they show symptoms, but severe CSSVD will kill traditional West African tree varieties in 2 to 3 years. In 1993-94, a virulent outbreak of CCSVD resulted in approximately 10 million cut trees, representing an immediate loss of US $20.2 million.

Farmers typically need considerable guidance on making the connection between early leaf symptoms and eventual tree death. To reduce infestation and create awareness, COCOBOD issues posters to help farmers and control officers recognize early symptoms. Early detection is crucial for limiting destruction in cocoa farms. Before the characteristic swollen shoots become visible, there are quite a wide variety of symptoms that manifest on mature leaves. Depending on cocoa variety and virus strain, these can include the reddening of primary veins in flush leaves; pinpoint to larger spots; diffused blotching; streaks; and yellow, white, or clear 'fern-patterns'.

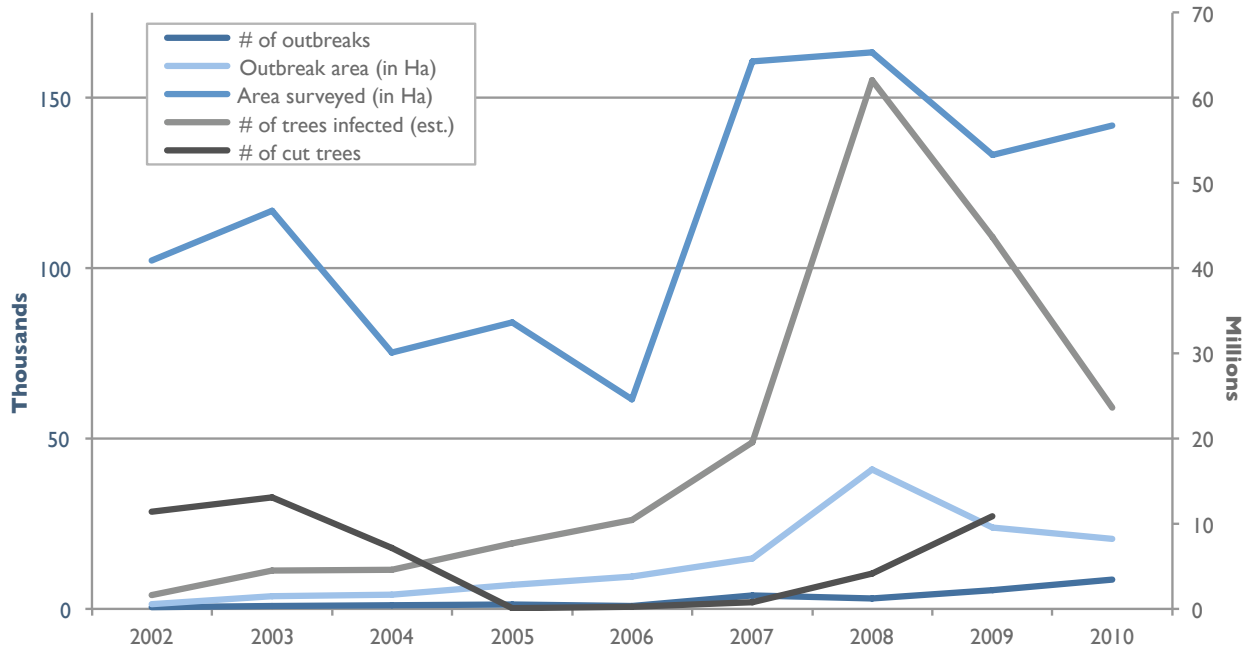
During the 1970s, studies looking at the use of early systemic insecticides to control mealybugs appeared to dismiss this method of control. This remains the most commonly held view. Surveying, diagnosis and replanting of infected areas remains the most effective (perhaps, the only) long-term control method. This is the approach adopted by the CSSVD Control Unit (CSSVDCU) in Ghana.

Control measures involve the eradication ("cutting out") of visibly infected trees and their symptomless immediate neighbors. Following cutting, stumps are treated with an herbicide to prevent regrowth. Such drastic treatment is understandably not popular with farmers. Before tree removal can take place, Control Units must negotiate with farmers. They often encounter resistance, which can lead to considerable delays and low compliance.

Figure 4.5 illustrates CCSVDCU activities during the period 2002-10. It depicts low tree removal rates in relation to the number of discovered outbreaks and estimates of infected trees. The result is higher rates of tree loss in the medium term, with inevitable tree death in 2-3 years. Since 2010, CSSVDCU has also practised a policy of removing and replacing old trees, even those showing no signs of infection.

Losses related to CSSVD and amounts COCOBOD pays to affected farmers as compensation after clearing are shown in Table 4.6. These figures represent losses only in year one. However, for farmers, the loss of future output and associated income during the 4-5 year period of maturation following replanting is not insignificant. Most farmers interviewed reported considerable delays in the 'ex gratia' payments.

FIGURE 4.5 - CSSVDCU OPERATIONS



SOURCE: CSSVDCU; COCOBOD Annual Reports

Much effort has gone into breeding to increase resistance to this disease in Ghana. However, specific resistance to the virus has yet to be found in local germplasm. Crosses using upper Amazon parents (clones 62, 67, 77, and 82) appear to be similar or better than existing material. CSSVD DNA can be transferred persistently from maternal parent to seedlings. Thus, research has focused on the use of somatic embryogenesis to generate disease-free clones.

TABLE 4.6 - CSSVDCU OUTBREAK ESTIMATES

Year	Outbreak Area (in Ha)	Crop Loss+ (in MT)	Price (US$/MT)	Loss/Gain (in US$)	*Ex-gratia* payments to farmers (in US$)
2007	14,898	5,617	1,790	$10,054,430	$264,780
2008	40,849	15,400	2,104	$32,401,600	$527,480
2009	23,844	8,989	2,400	$21,573,600	$1,131,050
2010	20,452	7,710	2,702	$20,832,420	N/A

SOURCE: COCOBOD Annual Reports

+Loss assumes average production of 377 MT/ha, and 100% crop loss due to removal of trees.

4.1.4 Other Pests, Diseases, and Weeds

Probability: Probable
Severity: Moderate

Farmers interviewed during the fieldwork highlighted a number of other pest-related threats to their crop. They include the following, in approximate order of importance:

4.1.4.1 Mistletoe

At least six different species of mistletoe have been found growing on cocoa trees in West Africa. One species (*Tapinanthus bangwensis*) accounts for about 70% of infestations in Ghana and is recognized by its red flowers and berries. It flowers twice a year and can live for up to 18 years. Mistletoe growth, if left

unchecked, can impact yield. Regular removal of mistletoe is essential for good crop management and large populations can be considered a sign of farm neglect. Mistletoe may also provide a suitable habitat for ants that cultivate CSSVD vectors.

4.1.4.2 Cocoa Stem-borers

Cocoa stem-borers are widespread across West Africa. They are also know to attack other crops such as coffee and cola. Regular outbreaks occur in cocoa producing countries in West Africa. In Ghana, the Ashanti, Brong Ahafo, and Western regions are most affected.

4.1.5 Drought/Dry Spell

Probability: Occasional
Severity: Moderate

By and large, Ghana's cocoa production belt receives sufficient rainfall and cocoa production has not been exposed much to drought stress. Nonetheless, the Harmattan winds are closely monitored by the industry as there does appear to be a causal link between severity of Harmattan winds and cocoa yields and quality. While many older farmers recalled hardships resulting from the 1982-83 drought, cocoa farmers as a whole consulted for this study did not consider drought to be a major risk. The early 1980s drought affected numerous districts, but perhaps most severely, in the north. The total crop loss does not appear to be significant even in this extreme year. Nonetheless, many climate change simulation models predict that weather-induced production losses might increase significantly in the future.

4.1.6 Bushfires

Probability: Remote
Severity: Moderate

Bushfires memorably accompanied the 1982-83 drought, causing localized severe tree losses. Based on data available, related losses are estimated at more than US$36 million. This historical event possibly marks the subsequent rise of the Western region as the most important cocoa region by the early 1990s. Bushfires can have a significant to severe impact on local cocoa communities whose trees (and thus, short-term to near-term livelihoods) are damaged or destroyed. However, its large-scale, widespread occurrence is relatively limited.

4.1.7 Cocoa Acreage Loss

Probability: Probable
Severity: Negligible

Loss of land devoted to cocoa production is yet another risk faced by the cocoa supply chain in Ghana. Principal drivers that could potentially contribute to acreage loss, and thus, a decline in output are: 1) increasing competition over land and labor from other sectors; and 2) declining terms of trade for cocoa, thereby encouraging farmers to switch to alternative, more remunerative crops (e.g., oil palm) or abandon their farms in search of off-farm employment.

Anecdotal evidence would suggest that growth in mining concessions and in localized illegal mining is encroaching on cocoa communities and other agricultural communities who depend on the same land for their livelihoods. A 2010 study[6] of Ghana's mining sector chronicled widespread abuses including lack of cooperation with and consent of local communities, corruption, and inadequate compensation. Most often, affected communities have little recourse as mining interests hold significant sway both at the federal and local levels. The lack of a transparent land use policy only adds to the uncertainty over land rights. This situation also serves as yet another disincentive for farmers to invest in replanting and productivity-enhancing upgrades.

[6] Ibid, 2010.

4.2 MARKET RISKS

In this section, the study analyzes major risks to the cocoa supply chain in Ghana that are related to market dynamics. Based on the analysis, cocoa price volatility and exchange rate volatility represent the most formidable risks facing the cocoa supply chain.

4.2.1 Cocoa Price Volatility

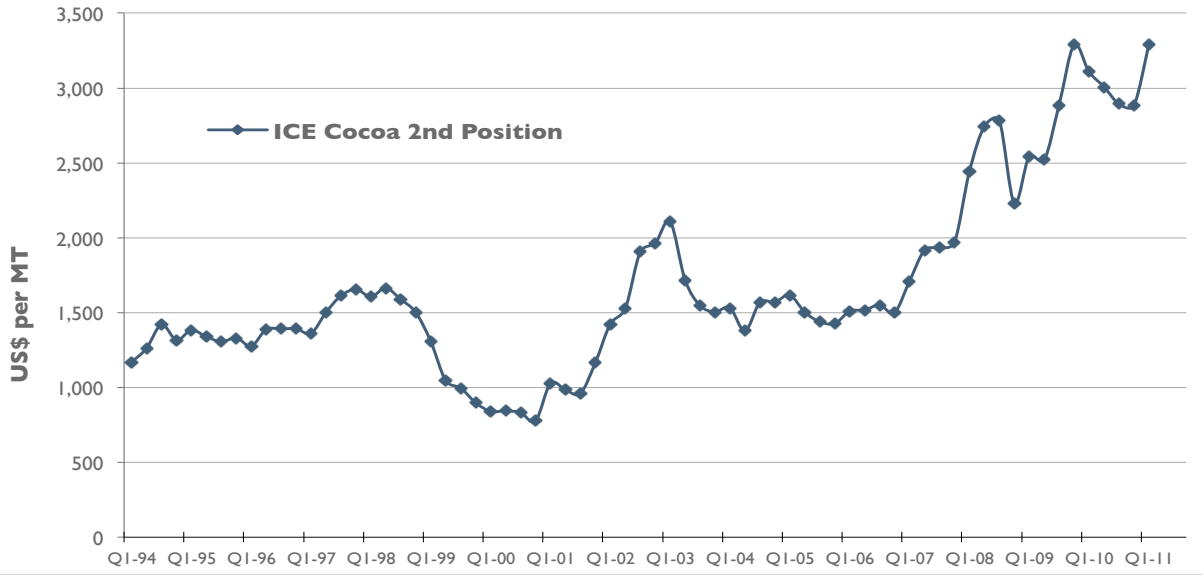
Probability: Highly Probable
Severity: Considerable

The short-term risk of cocoa price volatility is borne entirely by COCOBOD as it transfers the risk of freely floating international cocoa prices into the guaranteed price it provides to the farmer. In guaranteeing a fixed price, COCOBOD effectively absorbs price risk within the season from the farmer, as the international market is subject to freely floating prices. In addition, COCOBOD carries a significant cash flow obligation. COCOBOD is obliged to pay the farmer for his crop at the time of harvest while it only receives revenues post-shipment.

To mitigate these risks, COCOBOD markets a proportion of the crop in advance of the cocoa season through CMC. Through its pre-harvest forward sales program, CMC contracts a fixed price with international merchants, cocoa processors, and chocolate manufacturers for post-harvest shipment of cocoa. The forward contracts are then used as collateral against a syndicated loan that COCOBODC secures in advance of the harvest. The funds are passed from COCOBOD to the LBC in the form of a 'seed loan', which is used to finance the purchase and evacuation of cocoa from the farm/district level to COCOBOD.

COCOBOD's forward sales provide a notional value for the upcoming harvest. The Producer Price Review Committee (PPRC) references the average free-on-board (FOB) price to determine the actual farmer price that is to be paid that season. However, given that forward sales are based on forecasts of the crop size, CMC is unable to sell the entire year's crop in advance. This is due to the need to protect itself from defaulting in the event that total output falls below expectations. Thus, while COCOBOD's forward sales program effectively reduces farmers' exposure to price risk, this only applies to the 60-80% of the crop that is pre-sold. For strategic reasons, CMC withholds a portion of the crop to take advantage of potential price increases later in the season. However, in the event of a price drop, the unsold portion of the crop subjects CMC to a sizable price risk.

FIGURE 4.7 - INTERNATIONAL COCOA PRICE, 1994-2011 (US$/MT)



SOURCE: ICE Futures US

High levels of price volatility (Figure 4.7) on the open market pose certain risks. When international prices rise during the season, the margin between the price COCOBOD pays to the farmer and its international market sales price increases. This is reversed when international prices fall, as the margin between the price paid to the farmer and the sales price decreases. In crisis years, the margin can even turn negative. When international prices fall during the harvesting season, COCOBOD faces an economic loss on the portion of the crop that could not be sold forward. This risk is an inherent part of the COCOBOD fixed-price system and must be accepted as such. However, the management of this risk is a key component in determining COCOBOD (and therefore, ultimately, farmer) profitability.

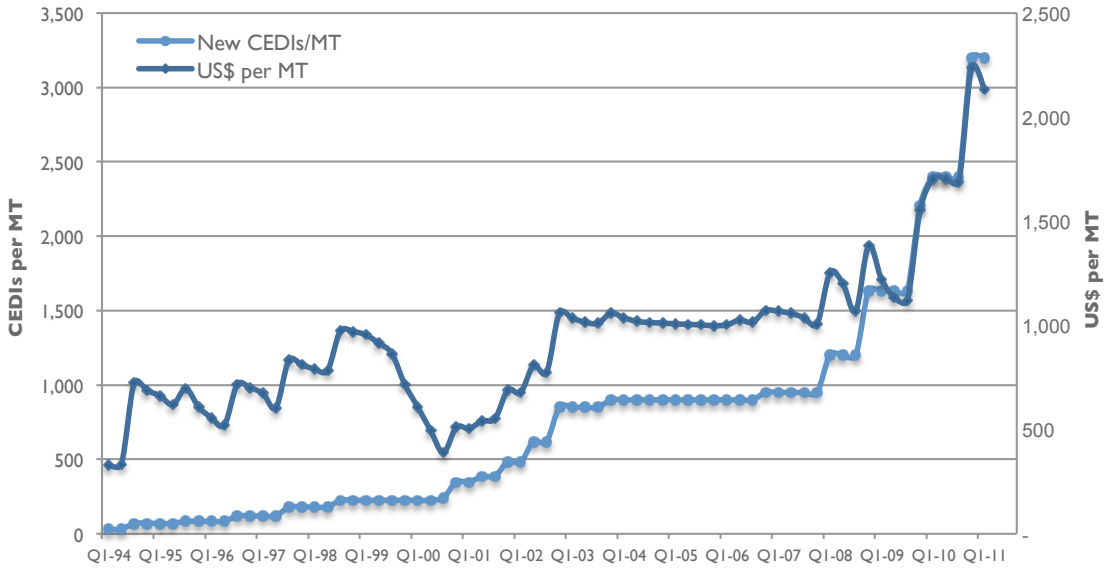
Volatility between the crop expectation and final crop out-turn limits COCOBOD's forward sales program to 60-80% of the expected crop. Illicit cross-border trade flows between Ghana and Côte d'Ivoire contribute to this uncertainty. Investments to improve capacity in combatting smuggling and crop forecasting systems could go a long way in reducing associated volatility. In addition, COCOBOD could consider leveraging financial instruments to protect against adverse price moves on the unsold proportion of the crop.

4.2.2 Exchange Rate Volatility

Probability: Probable
Severity: Moderate

Since launching the fixed-farmer price program, COCOBOD has never lowered the price. As shown in Figures 4.8 and 4.9, however, this is at least in part due to the steady devaluation of the Ghanaian Cedi, which has allowed local prices to increase even as international prices have fallen. Going forward, this could become a major concern, especially given recent statements from the Bank of Ghana targeting a 5 percent appreciation of the CEDI over the rest of 2011, and a more stable CEDI/US$ exchange rate.

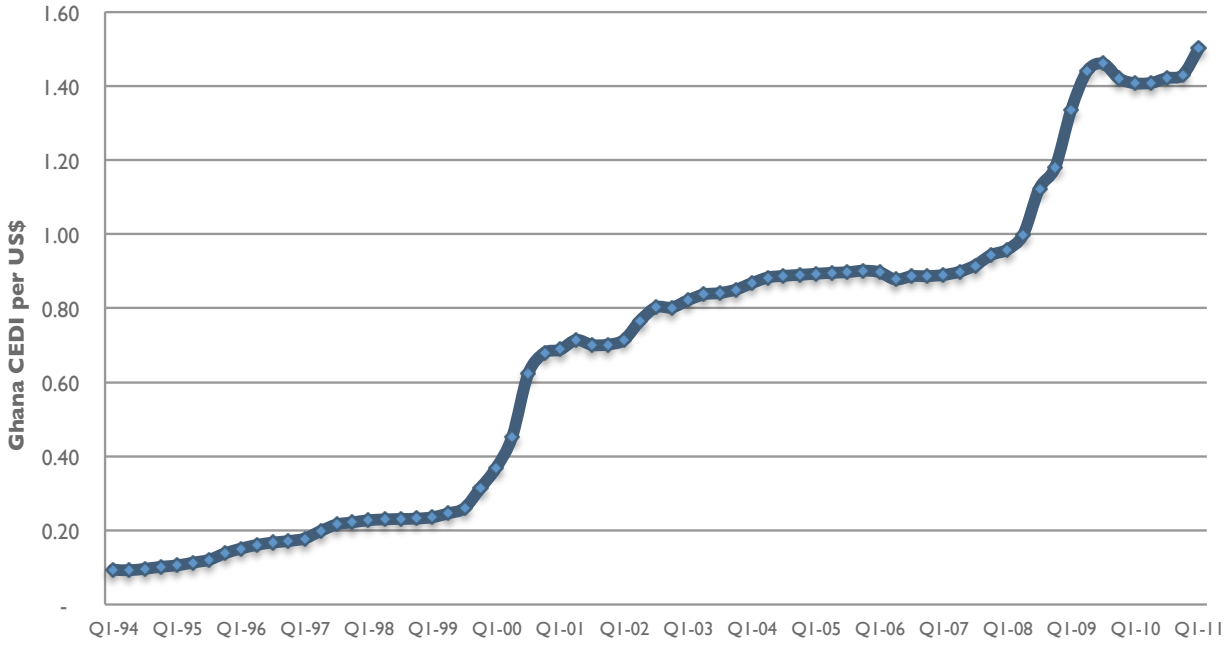
FIGURE 4.8 - GHANA FARMER PRICE, 2004-2011



SOURCE: COCOBOD Annual Reports

A stable or indeed appreciating CEDI would leave COCOBOD and the Ghanaian farmer with an even greater dependence upon international cocoa prices, which are currently at the highest levels since the late 1970. As the recent year-on-year increases in international prices are highly unlikely to be sustained in the medium term, the priority on a structural basis must be to increase revenues to the farmer by increasing yields per farmer and raising farmer's share of FOB prices though efficiency gains in the existing system.

FIGURE 4.9 - EXCHANGE RATE (Ghana CEDI vs. US$)



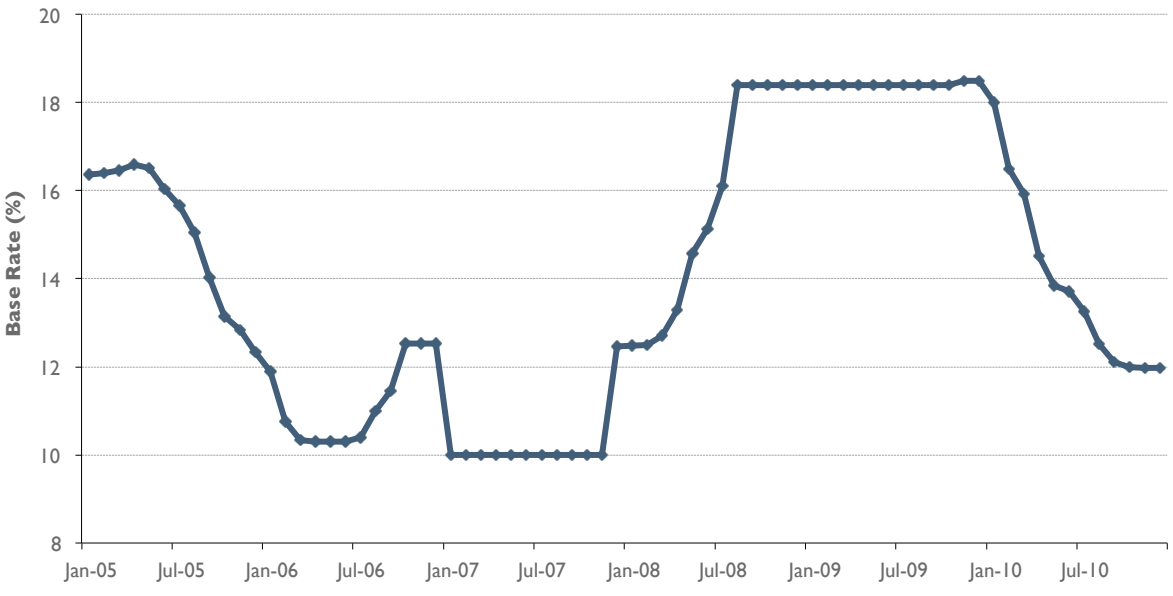
SOURCE: Oanda.com

4.2.3 Interest Rate Volatility

Probability: Occasional
Severity: Negligible

Many cocoa supply chain stakeholders in Ghana also face uncertainty over the costs of borrowing. According to the Bank of Ghana, interest rates jumped more than 85% in the 9 month period beginning in December 2007 (Figure 4.10).

FIGURE 4.10 - INTEREST RATE, 2005-2010



SOURCE: Bank of Ghana

In early 2010, rates dropped precipitously from 18.5% back down to just under 12% by the end of the year. Such a high rate of variability makes it difficult for LBCs, in particular, to borrow and manage their resources effectively. Many LBCs, given a lack of sufficient capital made available by COCOBOD through its 'seed loan' program, are forced to rely on local banks for the vast majority of their working capital needs. Interest rate spikes can result in unanticipated increases in financing costs. Actors also face high borrowing costs in domestic financial markets, a major constraint that serves to amplify such risks.

4.2.4 Input Price Volatility

Probability: Probable
Severity: Moderate

Volatility in prices for inputs such as fertilizers, pesticides, and herbicides can have impacts at all levels of the supply chain. Volatility in fertilizer prices, in particular, has increased dramatically in recent years (Figure 4.11). To hedge against this risk, stakeholders have developed their own risk mitigation mechanisms and behavior. Local input retailers try to cover the risk of price swings in their margin structure as farmer demand is typically highly price sensitive. Large dealers try and shift price risk to input producers through optimal timing and advance purchases to reduce the average cost or variance. Producers themselves try to stockpile fertilizer for peak demand periods.

FIGURE 4.11 - FERTILIZER PRICE INDEX, 1999-2010 (US$/ton)

SOURCE: USDA National Agricultural Statistics Service

Although input suppliers have exposure to changes in input pricing, these are issues for individual suppliers in an an open market. In fact, the major issues surrounding input usage relate primarily to credit constraints among farmers and the logistical challenge of supplying inputs to the right places at the right time.

4.2.5 Counterparty Risk

Probability: Probable
Severity: Remote/ Moderate

There are two major elements to counterparty risk in the cocoa supply chain. The first type of counterparty risk assessed is that between COCOBOD and its buyers. In selling the crop forward, COCOBOD enters into a contract to deliver beans at an agreed price with a select number of

international merchants, processors, and chocolate manufacturers. Although only one buyer[7] has ever defaulted on a contract with COCOBOD in the last 30-year period, there is little doubt that a high volume default would have a significant impact on COCOBOD's financial results.

While it remains unlikely that any major buyer would renege on a contract to buy from COCOBOD for reasons of price (a situation in which international cocoa prices fall between the time of purchase and time of shipment), it must be noted that the risk of default is not necessarily cocoa related. The bankruptcy of Lehman Brothers in 2008, the undoing in 2009 of leading cotton traders Paul Reinhart Inc. and Weil Bros Cotton, and subsequent buyout of Dunavant Enterprises by Allemberg Cotton Company has led to a reassessment of counterparty risk as market participants were once again reminded that even top-rated counterparties can and will go out of business.

In practice, COCOBOD seeks to allocate volumes among a wide range of buyers, thus limiting to the greatest extent possible its exposure to individual counterparties. Other forward sales mechanisms, including the use of futures contracts to separate the physical contract from the price risk management mechanism, could help reduce some portion of this risk.

To a more limited extent, COCOBOD is also exposed to counterparty risk with LBC who leverage the seed loan to purchase cocoa from the farmers and deliver the cocoa to COCOBOD. If an LBC failed to deliver the cocoa due to misappropriation of funds or theft, COCOBOD would face an economic loss on the value of the funds outstanding. It is worth noting that the top five LBCs purchase around 80% of total cocoa purchased in any given year (see Figure 3.2). Clearly, such a high level of market concentration raises the potential economic impact a default might have on the cocoa supply chain. This risk, however, is being managed by COCOBOD through getting local bank guarantees for seed fund advances to LBCs. In the event of a potential default by an LBC, the local bank (guarantor) will be obliged to pay.

By far the most important aspect of counterparty risk in the cocoa supply chain exists among input suppliers, farmers, and LBCs. As discussed in the previous chapter, input suppliers operate nearly exclusively on a cash-and-carry basis as a means of avoiding credit risks. Cash-strapped, many farmers look to their local LBC to provide inputs such as fertilizer on an informal credit or partial credit basis. In principal, LBCs have an incentive to offer credit and other value-added services as a means of attracting new farmers and maintaining loyalty among local farming communities. Indeed, COCOBOD's fertilizer distribution system relies largely on LBCs and their local buying stations to make fertilizers available to farmers. When extending credit to a farmer, local purchasing clerks anticipate recouping farmer debt during the harvest period by deducting the amount outstanding from the value of the cocoa sold. However, the practice of side-selling -when a farmer sells to another buyer to avoid repayment of debts - is widespread among Ghana's cocoa farmers and default rates are high. As a result, few purchasing clerks interviewed for this study were presently offering credit to their farmers. This has far-reaching impacts on the level of input usage, and thus farmer yields.

4.3 ENABLING ENVIRONMENT RISKS

This section analyzes major risks to the cocoa supply chain in Ghana that are related to the broader enabling environment. For the purposes of this assessment, enabling environment refers to, *inter alia*, regulatory, legal, and institutional frameworks, infrastructure and logistics, support services, and policies impacting the cocoa supply chain. This assessment identified four major risks. These relate to: 1) illicit cross-border trade; 2) logistics breakdown; 3) market regulation; and 4) and policy-making.

[7] For the crop year 1991-92, London-based Fergusson and Company defaulted on a COCOBOD contract for 1,150 tons of cocoa, representing a loss of US$1.4 million.

4.3.1 Cocoa Smuggling

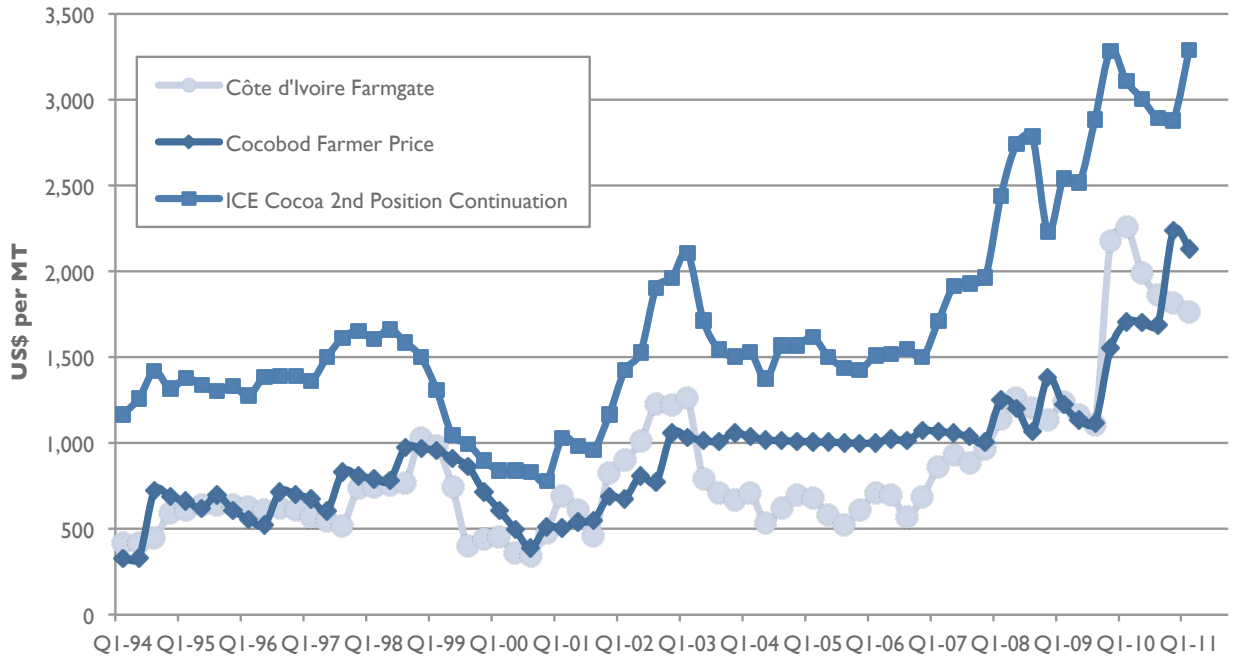
Probability: Probable
Severity: Considerable

As noted above, COCOBOD's primary intra-season market risk results from its inability to hedge the entire crop in advance, as the actual crop size is uncertain. Much of this uncertainty stems from production volatility, whether caused by variability in climate, outbreaks of pest and/or disease, or other production-related events.

However, another significant factor in purchase variability is cocoa smuggling. Each year, there are significant, and mostly unrecorded, flows of cocoa traded across Ghana's borders. The vast majority of this trade moves across the roughly 370-mile, largely porous border between Ghana and Côte d'Ivoire.

In contrast to Ghanaian farmers, who benefit from a guaranteed price, Ivorian farmers market the crop on a spot basis throughout the harvest period, with prices determined nearly exclusively by movement in international cocoa futures prices. As a result, whenever the international cocoa price moves higher or lower throughout the harvesting season, a price disparity is created. In a rising market, farmgate prices in Côte d'Ivoire can rise above the COCOBOD fixed price; in a falling market, the fixed farmer price in Ghana can remain significantly higher than the free market price paid to the Ivorian farmer (Figure 4.12).

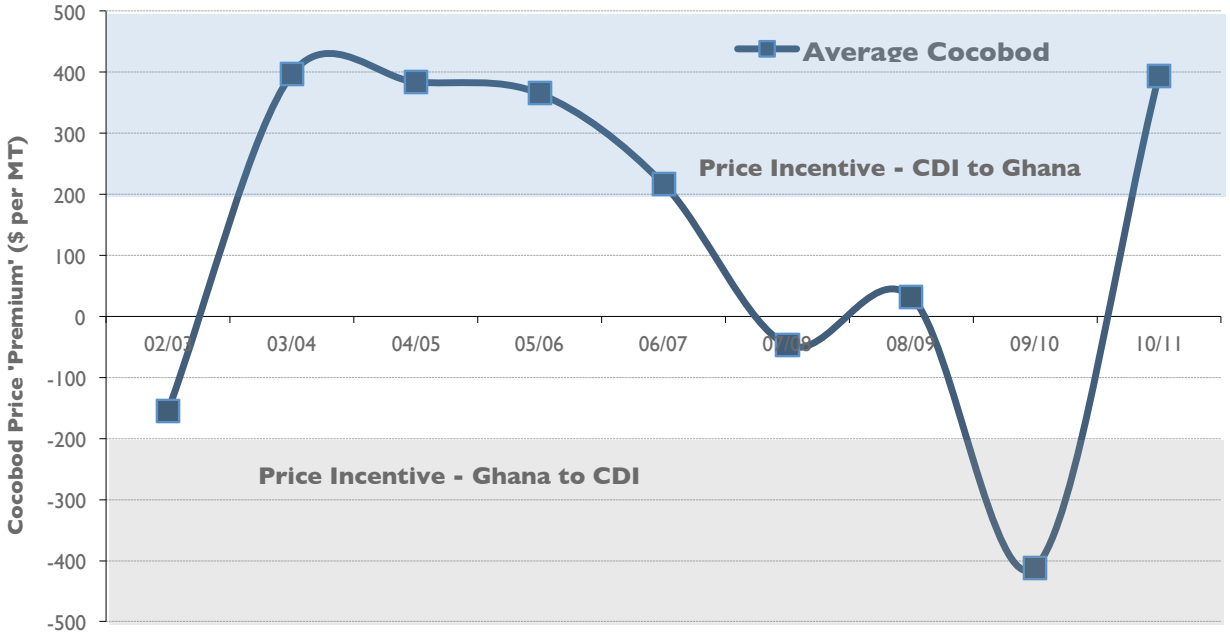
FIGURE 4.12 - COCOA PRICE COMPARISON (US$/ MT)



SOURCE: COCOBOD Annual Reports; Newswires; ICE Futures US

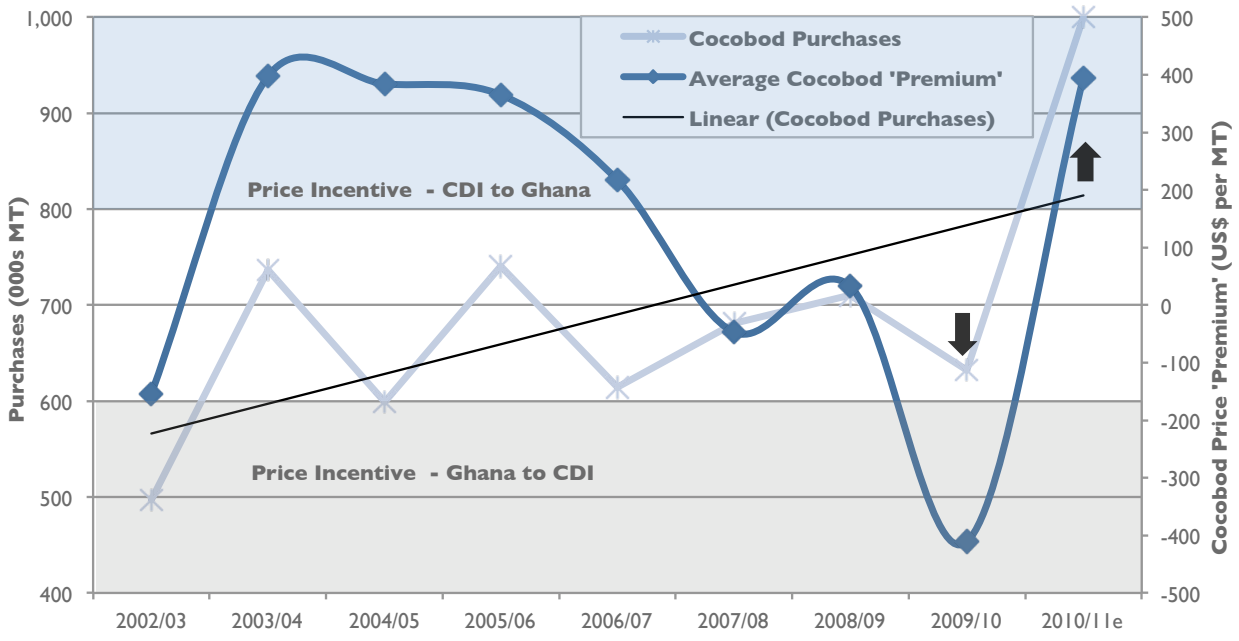
These price disparities, which effectively incentivize smuggling (Figure 4.13), appear to be responsible for a significant part of year-to-year variability in COCOBOD purchases, in turn hindering COCOBOD's ability to accurately forecast and hedge output. To illustrate this point, consider the increase in COCOBOD purchases during the period 2009/10 to 2010/11 (Figure 4.14). Across one season, purchases increased from 632,000 MT to an expected final 2010/11 total purchase number of 1,000,000 MT. As shown, this is an increase of 368,000 MT or 58%, and clearly well above the long-term trend growth in purchases.

FIGURE 4.13 - COCOBOD FARMER PRICE vs. COTE d'IVOIRE FARMGATE PRICE



SOURCE: COCOBOD Annual Reports; Oanda.com; Newswires; Author's calculations

FIGURE 4.14 - COCOBOD PURCHASES vs. PRICE DISPARITY



SOURCE: COCOBOD Annual Reports; Oanda.com; Newswires; Authors' calculations

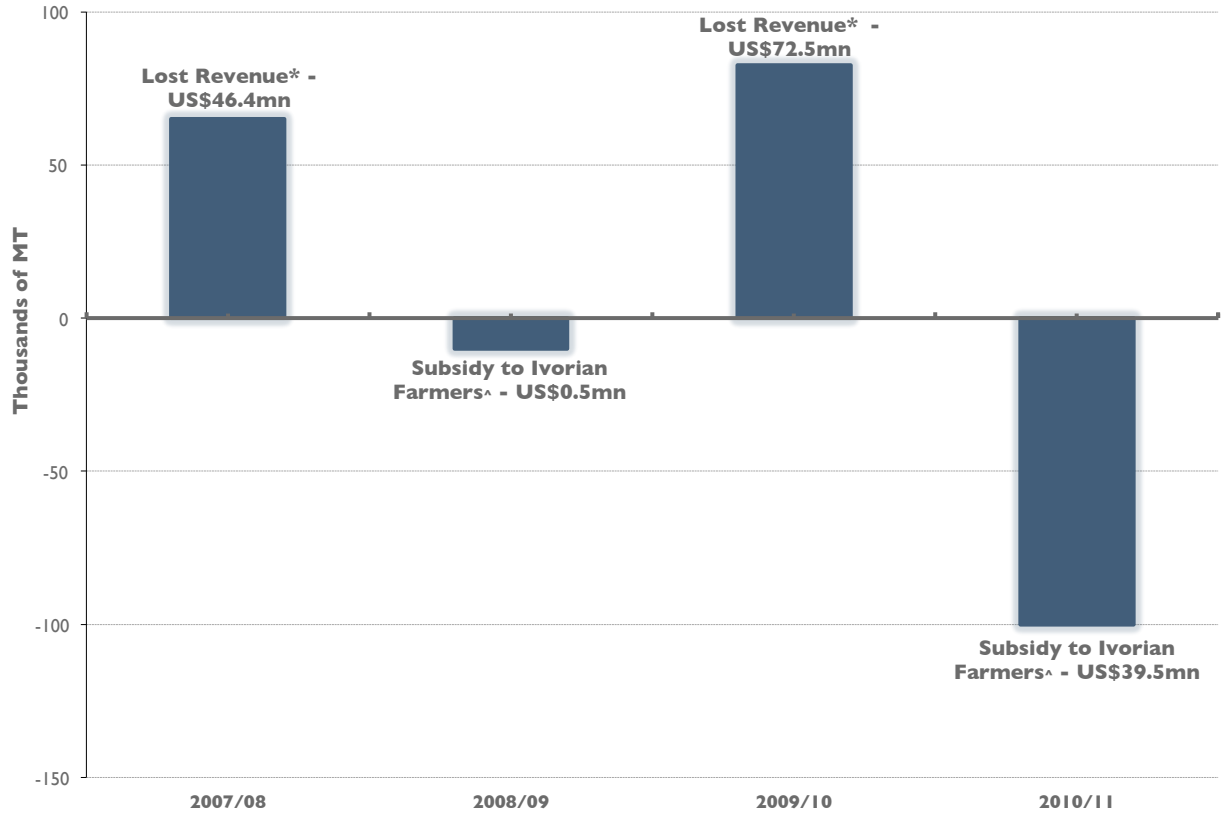
Even when taking into account other factors (more favorable weather, better tree husbandry, and COCOBOD input and spraying programs) that are clearly helping to improve yields, the above analysis clearly suggests that purchases in 2009/10 were reduced by an outflow of cocoa from Ghana to Côte d'Ivoire, while purchases in 2010/11 were swollen by an inflow of cocoa from Côte d'Ivoire to Ghana.

The illicit trade in cocoa has a direct impact on COCOBOD's bottom line. When cocoa flows from Ghana to Cote d'Ivoire, COCOBOD is unable to market and collect revenues and duties on the tonnage

smuggled. Figure 4.15 shows independent analyst estimates of the net flows of cocoa in the last 4 cocoa years. In 2009/10 alone, around 80,000 MT are believed to have flowed to Cote d'Ivoire. Based on an average international price of US$3,075 per MT and subtracting the 71% to account for farmers' share (see Annex A1), this translates to more than US$72 million of lost income that would have otherwise benefited the Ghanian economy.

From an Ivorian perspective, the effect of cross-border trade equalizes over time. During some years, Ivorian cocoa is lost to Ghana, but in other years Ghanaian cocoa flows in the opposite direction, generating supplemental tax revenues for Cote d'Ivoire. However, the risk is not symmetrically shared between the two neighbors. Cocoa is most likely to flow into Ghana when world market prices fall, that is to say, when COCOBOD's fixed price is above the world market price. When this happens, COCOBOD is effectively paying more for the cocoa than it can achieve by selling it to the international market, resulting in an economic loss. In 2010/11 alone, market analysts estimate that more than 100,000 MT of cocoa may have crossed the border from Cote d'Ivoire to Ghana.[8]

FIGURE 4.15 – AVERAGE MARKET VALUE OF COCOA OUTFLOWS, 2007/08-2010/11



SOURCE: Industry Sources; Newswires; COCOBOD Annual Reports
* Calculated based on 29% of FOB price multiplied by estimated volumes smuggled (in MT). See Annex A1.
^ Calculated based on differential between Ghana farmer price and average CDI farmer price multiplied by volumes smuggled (in MT).

4.3.2 Market Regulation Risks

Probability: Occasional
Severity: Moderate

Changes to regulations governing the cocoa market can have adverse impacts, especially when they happen abruptly. Regulatory risks can be local or national in nature or they can have their origin in the international market. The latter type represents the more substantial threat as downstream regulatory changes in the external market have the capacity to reverberate across the domestic supply chain.

[8] See *Inside Agriculture*. Reuters, 5 October 2011.

The current assessment identified two examples of regulatory risk as particularly noteworthy. These include: 1) ongoing shifts in import regulations over cocoa beans by major consuming countries; and 2) changes to international standards in response to child labor concerns. Through close cooperation and remaining responsive to industry concerns, COCOBOD has been able to successfully manage the latter risk. Regulatory changes relating to residues in cocoa bean exports represent a far more significant risk.

As discussed earlier, cocoa farmers use a wide range of pesticides to limit losses from pests and diseases. In recent years, cocoa consuming countries in Europe, the U.S. and Japan have increasingly expressed concerns over the health risks associated with the use of such pesticides. Several have taken specific action[9] via sanitary and phytosanitary (SPS), legislative and regulatory measures to stop importing cocoa beans with pesticide residues and other harmful substances. Such changes can hamper market access among producing countries, particularly if those countries are unprepared to respond.

Many authorities, in Africa as elsewhere, were unprepared for the recent changes to legislation in the European Union (EU) and Japan. From September 2008, assessment of the quality of cocoa imported into the EU included measurement of traces of substances that have been used upstream in the supply chain, including pesticides used on farms or in storage. In July 2008, EU agriculture ministers proposed even stricter controls, with a shift in emphasis from risk to hazard-based assessment of pesticides. Further legislative developments in other cocoa consuming regions (especially North America and Asia) need also to be reviewed on a consistent basis to ensure compliance.

Ghana is cooperating with, and can be considered a regional leader, in a number of initiatives, including an ICCO/STDF project to review such sanitary and phyto-sanitary (SPS) issues and implement effective measures for their mitigation. To date, these have especially focused on pesticide residues, which are best managed with good agricultural and warehouse practices. The details of the proposed legislation may take several years to be agreed upon, but research institutes in cocoa producing countries such as Ghana must now consider how best to manage key pest species. Maintaining a range of active ingredients, rather than single products within a modes of action group, is a straightforward way of mitigating this risk.

4.3.3 Policy Risks

Probability: Occasional
Severity: Moderate

Ghana offers a highly conducive policy environment for cocoa. GoG has consistently emphasized subsector growth and provided strong support to the subsector in recent decades. The policy-making process is viewed as broadly inclusive and transparent. The framework's current multiyear (2010-13) program, called the 'Ghana Shared Growth and Development Agenda', maintains GoG's strong emphasis in supporting the cocoa subsector as an important growth engine. In addition, COCOBOD's PPRC has an institutionalized internal decision-making process in which all stakeholders are represented and given an opportunity to express their views and lobby for their interests.

Notwithstanding the above, this assessment identified two major policy risks that hold strong potential to curtail investment and derail the subsector's recovery if left unchecked. These include: 1) uncertainty over future GoG support to the domestic cocoa processing industry; and the 2) the absence of a national land use plan. In interviews, a number of stakeholders expressed concern over their inability to anticipate future changes to GoG's incentive program. Chief among concerns was whether or not the government would continue to supply light crop beans at a discount to processors once the initial 5-year period had expired. Another issue raised frequently during stakeholder consultations was how GoG would respond to skyrocketing energy costs. Similarly, the absence of a land use policy places a question mark for many stakeholders over how GoG plans to address growing competition over land among leading sectors of the economy.

[9] In 2006, Japan's Chocolate and Cocoa Association rejected more than 2,000 metric tons of Ghanaian cocoa for containing abnormally high residue levels.

4.3.4 Logistics Breakdown

Probability: Probable
Severity: Moderate

Logistics is yet another source of risk facing cocoa supply chain stakeholders in Ghana. Chronic congestion at COCOBOD's three primary takeover centers and periodic ruptures in the supply of essential marketing materials such as jute sacks are two notable examples of logistical challenges that can result in financial losses among stakeholders.

Rising output in recent years has increasingly strained existing storage capacity and led to considerable congestion at the Kaase inland depot and Tema and Takoradi port facilities. According to anecdotal evidence, wait times to offload cocoa at certain periods can be up to 5 days or more. For LBCs, this can significantly reduce their 'turnaround' rate, or the time it takes to aggregate, process, and deliver a consignment of cocoa.

By tying up capital in existing stocks, these delays effectively limit LBCs' capacity to rollover funds into new purchases to generate more revenues. LBCs can also face higher marketing costs due to the interest on borrowed capital. As an example, the seed loan made by COCOBOD was available at an annualized interest rate of 12% in 2010/11. Based on COCOBOD's estimated 'turnaround' period of 25 days, this cost equates to roughly 0.8% of the FOB price. However, based on anecdotal evidence, the actual 'turnaround' period was widely reported to be roughly 50-60 days. This is due to logistical breakdowns along the supply chain, mostly relating to offloading delays at the CMC takeover centers. These delays, in effect, raise the cost of financing to approximately 1.8% of the FOB price, according to the team's analysis. In addition, logistical delays raise the possibility–and the risk borne exclusively by LBCs–that the cocoa may be damaged while in transit through exposure to moisture or other elements.

COCOBOD has taken steps in recent years to increase existing storage capacity and improve overall logistics. For instance, it implemented a quota and scheduling system for LBCs to help better coordinate deliveries and reduce congestion, though with reportedly mixed results. Investments in port upgrades at Tema and Takoradi within the last 10 years have drastically improved handling and loading times. New initiatives have also included the outsourcing of warehouse management services and the construction of new storage facilities (including a 100,000-ton facility at Takorodi) that will undoubtedly ease some of the bottlenecks once commissioned.

4.3.5 Misappropriation of Funds

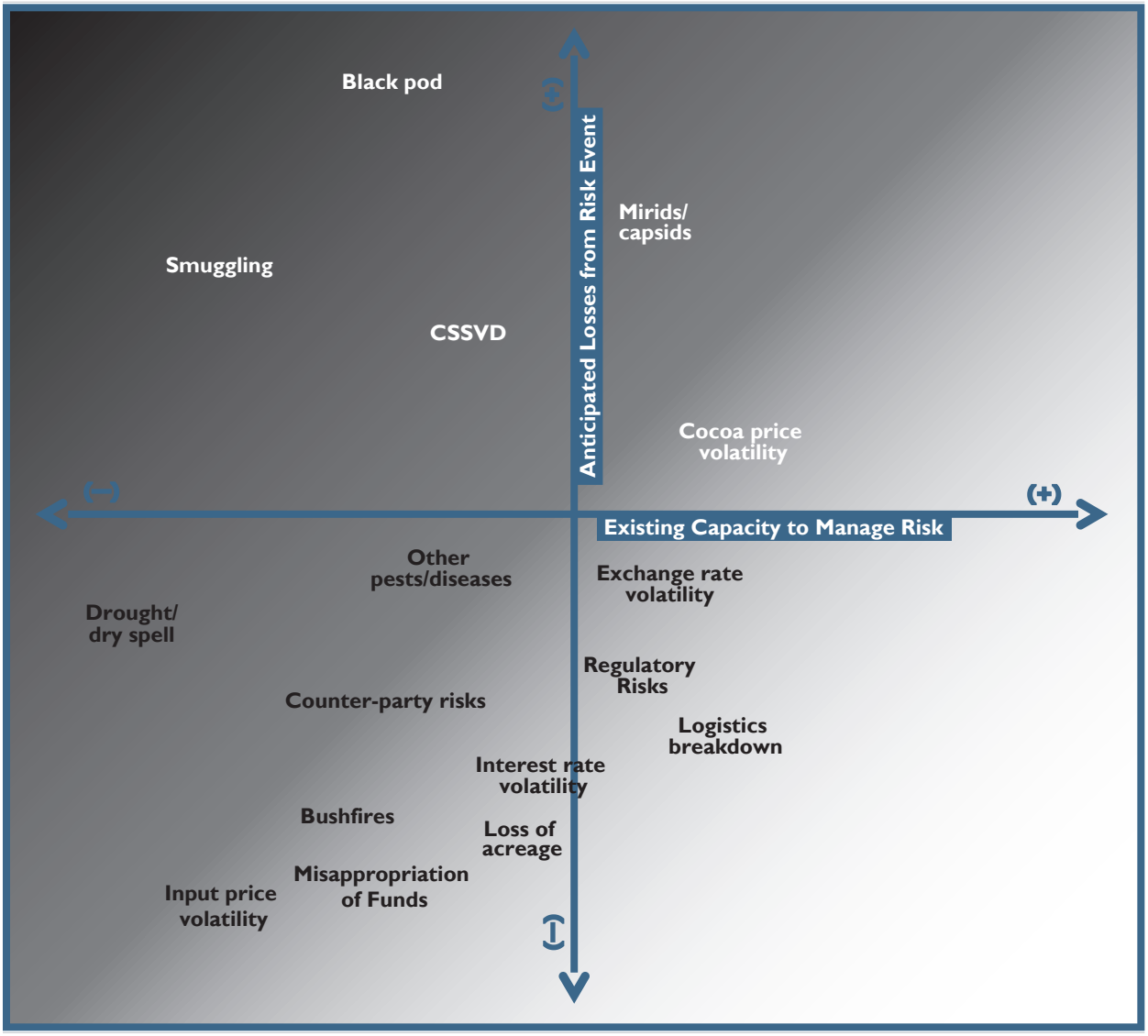
Probability: Probable
Severity: Negligible

In addition to operational risks linked to the external environment, LBCs face internal risks. Based on the responses of those interviewed, principal among these are financial management risks related to the misappropriation of company funds and assets. Though difficult to estimate, associated annual losses stemming from theft or embezzlement are thought to be considerable. In efforts to combat such risks, some of the largest LBCs have made sizable investments in recent years in upgrading their book-keeping and workflow processes. However, the majority of LBCs remain ill-equipped to guard against large-scale theft or fraud. Operating on slim margins with limited working capital and scant reserves, relatively few LBCs have the capacity to absorb the loss and recover quickly when they fall victim. Nevertheless, while often severe at the company level, the impact of corporate theft at the broader, sectoral level is relatively inconsequential.

5.0 VULNERABILITY TO RISK

Following the previous section's discussion of key risks threatening the cocoa supply chain in Ghana, this section appraises each risk according to the level of stakeholder vulnerability. For the purpose of this exercise, vulnerability is defined as a function of: 1) the relative capacity of various stakeholders to adapt to a given risk type; and 2) the severity of losses among relevant stakeholders resulting from a risk event. This final step in the analysis affords not only a more comprehensive assessment of the degree of risks, but it also helps identify priorities for intervention that have the potential to improve risk management systems that are currently in place. At this stage, the analysis seeks to pinpoint potential gaps in prevailing risk management mechanisms where current investments may be insufficient in light of the level of vulnerability observed. Based on the information that was collected during the initial analysis and subsequent consultations, the team evaluated the observed capacity of stakeholders to manage the supply chain risks. The results are shown in Table 5.1.

TABLE 5.1 - MEASURE OF RISK VULNERABILITY



SOURCE: Authors

6.0 PRIORITY MEASURES FOR IMPROVED RISK MANAGEMENT

Previous sections identified and analyzed key risks to the cocoa supply chain and prioritized them based on measures of vulnerability and capacity to inflict financial losses among stakeholders. This analysis has enabled the assessment's identification of the top five most critical risks. These include in order of importance: 1) black pod disease; 2) mirids/capsids; 3) CSSVD; 4) cocoa price volatility; and 5) smuggling. Table 6.1 lists a range of targeted measures designed to address these risks. Proposed measures are classified into the following three groups:

1. Risk Mitigation - Investments designed to eliminate or reduce the likelihoods of risk events from occurring, or to reduce the severity of losses.
2. Risk Transfer - Tools or mechanisms that transfer the risk to a willing third party, at a cost (e.g., insurance, reinsurance, financial hedging tools).
3. Risk Coping - Investments that will help those affected cope with the losses caused by a risk event (e.g., government assistance to farmers, debt restructuring)

The following list is by no means exhaustive, but is meant to illustrate the type of investments that, based on the analysis, have strong potential to maximize COCOBOD's allocation of resources while building upon and strengthening its current risk management strategy.

TABLE 6.1 - PRIORITY MEASURES FOR RISK MANAGEMENT

Identified Risk	Proposed Risk Mitigation	Proposed Risk Transfer	Proposed Risk Coping
1. Black Pod Disease	1. Improved agronomic practices (e.g. tree height reduction, opening of canopy, better pruning) 2. Farm level (vs. top-down) decision making about fungicide application 3. Private sector distribution channels to improve availability of fungicides 4. Strengthen extension support mechanisms 5. Timely delivery of 'Not-for Sale' fungicide to farmers 6. More efficient spraying techniques 7. Early warning system for early identification, detection, and communication of impending pest/disease outbreak		1. Better agronomic practices 2. Efficient application of fungicide and spraying techniques 3. Timely delivery of 'Not-for-Sale' fungicide

Identified Risk	Proposed Risk Mitigation	Proposed Risk Transfer	Proposed Risk Coping
2. Mirids/ capsids	1. Evidence-based, transparent selection of wider range of registered pesticides 2. Improved selection of motorized mist-blowers 3. Further operational-scale research into improved application techniques 4. Operational and private supply of insecticides 5. Training of next generation pesticide scientists		
3. CSSVD	1. Promote better agronomic practices 2. Develop real-time CSSVD outbreak alert system 3. Collaborate with international/domestic commercial tracking teams 4. Improve the transparency, efficiency, and timeliness of tree cutting and *exgratia* payments 5. Mass campaign/awareness building		1. Improve the transparency, efficiency, and timeliness of tree cutting and *exgratia* payments
4. Cocoa Price Volatility	1. More precise crop forecast (incorporating cross border informal trade) 2. Increase share of specialty market 3. Increase share of forwards contract	1. Explore the use of futures contracts to combat liquidity constraints 2. Explore the use of options to protect the unsold crop portion	1. Professional management of COCOBOD's existing price stabilization fund
5. Smuggling	1. Acknowledge full scope of problem 2. Engage in policy dialogue with the Government of Cote d'Ivoire 3. Increase border control measures/resources to better monitor and deter flows 4. Step up intelligence-gathering efforts and analysis 5. Expand Anti-Smuggling Initiative		1. Acknowledge full scope of problem 2. Engage in policy dialogue with the Government of Cote d'Ivoire 3. Use of options on futures 4. Step up intelligence-gathering efforts and analysis 5. Anti-Smuggling Initiative

6.1 RECOMMENDATIONS FOR IMPROVED RISK MANAGEMENT

GoG through COCOBOD has invested considerable resources into addressing a number of key supply chain constraints and risks that threaten growth and stakeholder livelihoods. These include pests and diseases, aging trees, low productivity, and cocoa price volatility. Nevertheless, a key finding of this assessment is that strong scope exists for COCOBOD to further strengthen its current risk management mechanisms and secure a better return on existing investments through better prioritization of risks and allocation of resources. This section provides some recommendations for consideration.

6.1.1 Black Pod Disease

From an operational point of view, the difficulties in obtaining fungicides and virtual absence of copper fungicides or metalaxyl in private pesticide stores is a matter of great concern. The lack of availability of fungicides, particularly at the start of the rainy season, exacerbates the risks posed and losses sustained by black pod disease. Effective cultural practices, coupled with timely sprays by farmers, are known to be highly effective and crop losses need not exceed 5-10%.

With the highest importance given to black pod disease, especially *P. megakarya*, one of our key recommendations must be the need to introduce "Integrated Pest Management (IPM) friendly" tree architecture into the cocoa gardens themselves. With tall trees it is virtually impossible to: 1) monitor for disease/insect symptoms; 2) spray efficiently; and 3) harvest regularly. Various remedial techniques are known to work, [10] including grafting, or even simple cutting for regrowth at 1-2m height. However, at least two farmers interviewed feared that their trees might be harmed. It is possible that this is a widely held concern among cocoa farmers, and therefore, will likely require a substantial extension exercise.

Farmers interviewed often highlighted the challenge of securing fungicides and other inputs. Chronic delays in the delivery of COCOBOD-supplied fungicides for black pod management was also an oft-cited challenge. Lack of timely availability of needed fungicides amplifies impacts from the disease's spread. Dissemination of better disease management tools, including 'IPM friendly crop architecture', would have the added benefit of helping to manage potential threats of invasive diseases. It could also dramatically alter the economics and viability of the entire cocoa crop in the region. Tree height control also has important implications for invasive species management (see Annex A5).

COCOBOD might therefore consider:

- A major campaign specifically to reduce tree height on farms, coordinating the efforts of researchers, NGOs, plant breeders, *etc.*
- Improved application techniques to improve efficacy by reducing waste in application with hydraulic sprayers, with specific recommendations on fitting suitable nozzles. Possible rationalization of recommended machines, emphasizing quality before price.
- Removing fungicide spraying from the remit of CODAPEC so that it can focus on more effective mirid control.
- Developing mechanisms and organizational frameworks for private supply and better market availability of black pod disease fungicides.
- Improving regulation of fungicides to ensure quality and compliance with the SPS requirements of importing countries. Monitoring of stores to remove illegal fungicide products is also important to protect farmers' health, lower the risk of unacceptable residues, and ensure that farmers have access to the best quality products.

[10] Bateman 2010, *ibid.*

- Investing in the development of early warning systems that would greatly reduce the time it takes for a pest/disease outbreak to be detected, identified, and reported so that appropriate response mechanisms can be initiated to combat the problem.

6.1.2 Mirids/Capsids

The findings of this analysis largely support CODAPEC's continued supervised control of mirids with insecticides. Section Four describes some of the technical reasons for maintaining mass spraying programs. However, CODAPEC spray gangs are not, based on our earlier analysis of CODAPEC's operations, achieving the minimum two sprays. In addition, suitable, registered insecticides are not available to farmers in the open market to complement CODAPEC applications when additional applications are required.

The assessment team recommends that emphasis here should be placed on:

- Better, more evidence-based and transparent selection of a range of registered products.
- Improved selection of motorized mist-blowers, emphasizing quality (vs. low cost) and ease of maintenance. This would entail reducing the range of approved machines.
- Increasing operational-scale research into improved application techniques, with an emphasis on combining good spray coverage with minimal spray volumes (and thus insecticide costs).[11]
- Devise mechanisms by which registered, non-CODAPEC insecticides can be distributed more easily via commercial suppliers.
- Tight regulation of insecticides is likely to continue, with continued loss of available active substances for the EU market. Ghana and its neighbors need to stay "ahead of the game" by investing in training of the next generation of pesticide scientists.

6.1.3 CSSVD

COCOBOD's CCSVDCU control activities focus on identification of affected areas and targeted cutting of diseased trees. Analysis of these operations suggest that farmer resistance, insufficient resources, and other factors limit treatment to only a small portion of total affected areas. In addition, the lack of sufficient supply of hybrid material for replanting raises risks that farmers are replanting with suboptimal varieties. These factors inevitably amplify the impact of CSSVD and other invasive diseases, particularly over the medium-term.

To improve risk mitigation and risk coping mechanisms currently in place, the Assessment Team proposes the following measures:

- COCOBOD should consider more limited, but focused control operations in the very worst affected areas- ones with the best potential for yield improvement. Full and timely compensation and support for the farmers affected is also critical to strengthen and maintain program credibility among farmers.
- COCOBOD should expand the objectives and execution of seedling production and replanting activities beyond CSSVD control and replacement of old trees. In Ghana and many other countries, both research and seedling production units have tended to separate-out plant breeding and IPM approaches: understandably, given the different skills involved.

[11] Jessop NH, Awudzi G, Bateman RP 2010. How best to spray cocoa with motorised mistblowers? *Aspects of Applied Biology*, 99: 191-196.

- In the long term, COCOBOD should encourage breeders and nurserymen to change to pruned, managed clones, which are generally as preferable to hybrid seedlings. In addition, more resources should be allocated for research leading to early availability of superior varieties.
- CRIG should consider strengthening research into seed production, distribution, and medium-term (six months) seed storage technology.
- COCOBOD should bolster efforts to raise awareness among farmers, crop scouts, and others of CSSVD and other invasive species, particularly of the *Moniliophthora* diseases. Continued vigilance is, of course, essential to prevent invasive species entering the country by the usual quarantine methods, etc. However, knowledge of their existence and symptoms appears to be limited apart from researchers at CRIG.
- In order to address a number of important issues, the Team recommends in particular urgent introduction of 'IPM friendly' varieties (compact or plagiotrophic trees that effectively limit farm tree height to approximately 3 meters) where pods can be accessed more easily at ground level.

6.1.4 Cocoa Price Volatility

To hedge against price volatility in the international market, CMC currently sells 60-80% of the crop in advance, entering directly into forward sales contracts with international merchants, cocoa processors, or the chocolate industry. This system essentially works well, although it does expose COCOBOD (through CMC) to potentially significant counterparty risks. However, in discussing the forward sales program with CMC, it was apparent that liquidity can be a significant constraint. In general, CMC aims to market cocoa as prices rally, just as the international chocolate industry seeks to buy whenever prices dip. As a result, liquidity is often in short supply at the precise same time CMC wishes to sell.

To reduce GoG's exposure to price volatility, the assessment team propose the following:

- COCOBOD should begin to develop the ability to hedge futures independently, putting the mechanisms into place with small volumes at first. This would allow CMC to optimize their sales price, selling small quantities as and when liquidity allows. The physical sale would become independent from the futures hedge, giving the added advantage of increasing transparency and competition among the international buyers and thus enabling CMC to aim for the highest possible physical differential[12] and the highest possible futures price.
- COCOBOD should work hand-in-hand with several international banks, taking full advantage of their internal expertise to develop a basic futures hedging mechanism to be implemented alongside the current forward sales program. By placing the banks into competition, COCOBOD should also expect to develop this program on a margin-free basis, thus avoiding the cash flow constraint that has long been considered a major restriction of futures hedging.

6.1.5 Smuggling

Illegal, cross-border trade in cocoa has long been a challenge for GoG. Smuggling flows increase the volatility of purchase volumes, making it even more difficult to accurately project crop flows. This volatility in turn prevents CMC from marketing a higher proportion of the crop in advance of the harvest period, thus amplifying COCOBOD's exposure to intra-season cocoa price and exchange rae volatility.

[12] The physical differential is the difference between the outright cocoa price and the international futures market. For example, if Ghana cocoa is trading at $3300 per MT versus the international futures benchmark of $3100 per MT, the differential would be +$200 per MT. In general, differentials are significantly more stable than the outright price (i.e., outright price = futures price +/- differential price).

To mitigated associated risks and help COCOBOD and other supply chain stakeholders better cope with the impact of smuggling, the assessment team recommends the following:

- GoG should openly acknowledge that smuggling occurs both from Ghana to Cote d'Ivoire (as is currently acknowledged) but also from Cote d'Ivoire to Ghana (which is rarely acknowledged). Illicit flows do not appear to damage quality, as any cocoa arriving in Ghana must fulfill COCOBOD's extensive quality control criteria, and the physical market continues to pay a premium for Ghana cocoa in comparison to other West African origins.
- Following full recognition of the problem's scope, GoG should engage in a formal dialogue with the government of Cote d'Ivoire, allocating additional resources along the border in order to restrict smuggling flows. As shown, independent market analysts estimate that flows in some years can be in the magnitude of 100,000 MT. As a result, it would seem that there is a significant budgetary incentive on both sides of the border to combat smuggling.
- COCOBOD should consider the use of options on futures as a hedging mechanism to better manage existing exposure to extreme intra-seasonal price movements. Although the cost of options is often seen as prohibitive, it should be remembered that these would only be used on the 'unknown' portion of the crop, which cannot currently be hedged in advance, and as such the cost as a proportion of the overall FOB price should be considered.

7.0 CONCLUDING REMARKS

The purpose of risk management is to anticipate threats to existing operations and future growth. Understanding the nature of those threats and which threats represent the biggest sources of risk is essential to effective risk management. The result is improved decision-making as to where best to allocate resources for optimal return on investment and reduced uncertainty.

This study has assessed key risks within the cocoa supply chain in Ghana. The study has analyzed each type of risk using available quantitative and qualitative data to identify the frequency of related events over time and the severity of their impact on stakeholder livelihoods. Resulting estimates of financial losses and measurement of existing levels of vulnerability enabled subsequent prioritization of these risks. The study's main conclusion was that pests and diseases pose the greatest risk to the subsector. Among these, black pod disease was found to pose the single biggest threat. In addition, the study concluded that existing control measures fall short of what is required for effective risk management.

This analysis provided the basis for a set of recommendations described in the previous section. Proposed interventions are by no means exhaustive and are meant to be illustrative of the type of investments that have the potential to strengthen current risk management mechanisms that are already in place. However, it is hoped that the study's findings and related recommendations will serve to inform and guide continuing and future efforts on the part of GoG and its development partners to develop and implement a comprehensive risk management strategy that will lead to a prosperous and sustainable supply chain for all stakeholders.

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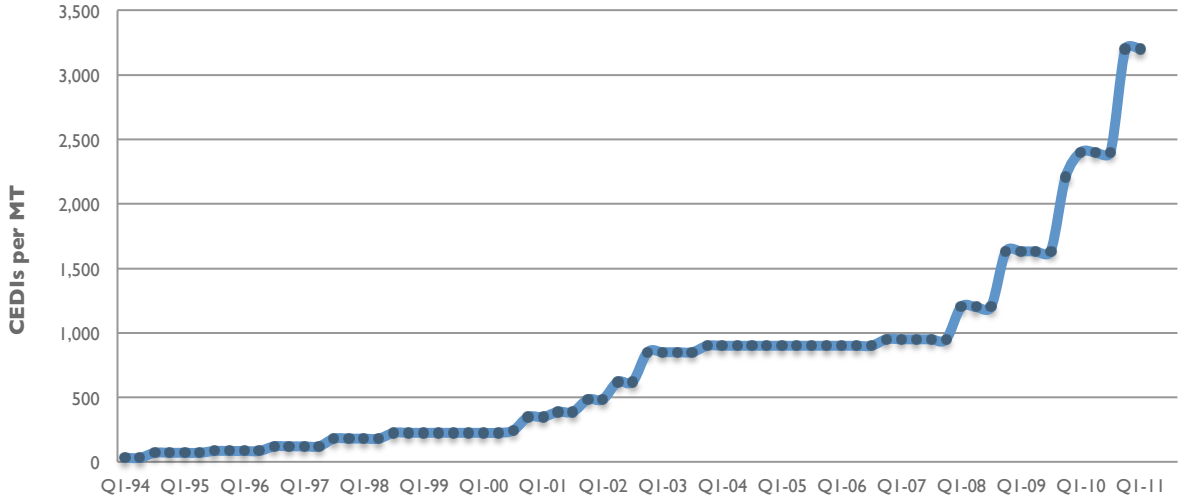
ANNEX A1 - FARMER PRICE OVERVIEW

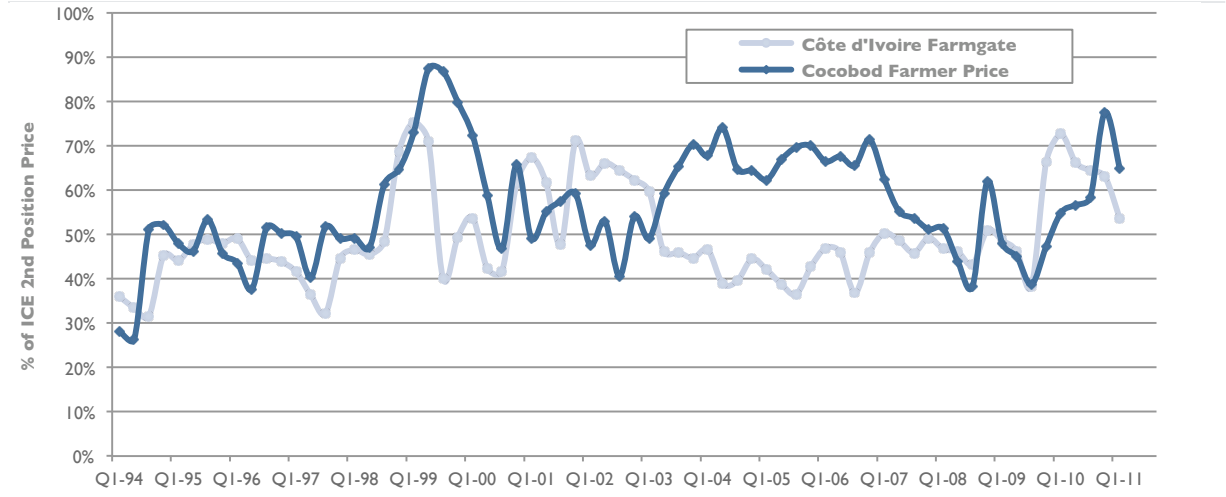
Through COCOBOD, the Ghanaian government offers its cocoa farmers a fixed Cedi price throughout each October-September cocoa season. The farmer price is determined at the outset of the season by the PPRC, which comprises COCOBOD officials, a farmer's representative, government representatives and representatives of the LBCs. Although COCOBOD has on occasion adjusted the 'farmer price' upwards during the course of the season to take into account rising international prices, it has never decreased the price, at least in Cedi terms (see Figure A1.1).

FIGURE A1.1 - COCOBOD FARMER PRICE



SOURCE: COCOBOD Annual Reports

FIGURE A1.2 - FARMER PRICE COMPARISON (% of Terminal Market Price)



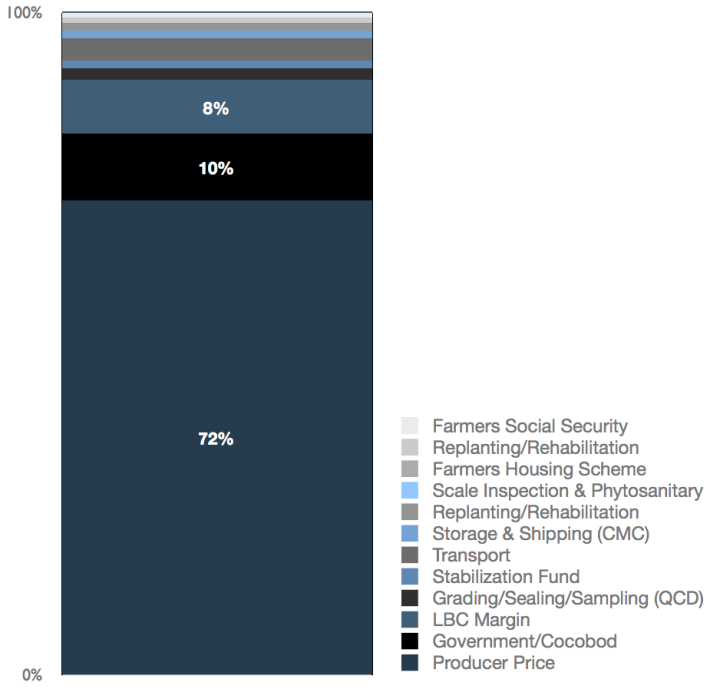
SOURCE: COCOBOD Annual Reports

Historically, the fixed price achieved by COCOBOD compares favorably to the equivalent price paid in neighboring Côte d'Ivoire, averaging 58% of the international price,[13] compared with 51% in Côte d'Ivoire (See Figure A1.2).[14] In addition to a guaranteed price, the Ghanaian cocoa farmer receives numerous benefits from COCOBOD, as detailed elsewhere in this report.

[13] International Cocoa Price – New York Terminal Market, 2nd Position Average – measured quarterly since 2000.
[14] Côte d'Ivoire farmer price series basis historical newswire reports.

As shown in Figure A1.3 and Table A1.4, COCOBOD aims for a farmer price that is at a minimum 70% of the pre-harvest net FOB price. In 2009/10 the PPRC determined that producers would receive 71% of the FOB price, while the remaining 29% of revenues would be allocated to support activities and programs across the supply chain.

Figure A1.3 - FOB PRICE SHARE, 2009/10



SOURCE: COCOBOD Annual Report, 2009/10

TABLE A1.4 - FARMER PRICE CALCULATION, 2009/10

Average FOB Price (est.)	US$ 2400/MT
Exchange Rate (est.)	1.46 CEDI/US$
Crop Size (est.)	700,000 MT
Deductions	
Disease & Pest Control	162.6 Mn CEDI
Scholarship Fund	10.0 Mn CEDI
Jute Sacks	19.8 Mn CEDI
CSSVD	14.1 Mn CEDI
Hi Tech	69.4 CEDI
Child Labor Certification	2.0 CEDI
TOTAL	277.9 Mn CEDI
	US$ 271.9/MT
Net FOB Price	US$ 2128/MT
Farmer Price	2208 CEDI/MT US$ 1512/MT
Share of Net FOB Price	71%

SOURCE: COCOBOD Annual Report, 2009/10

ANNEX A2 - OTHER THREATS TO THE COCOA SUPPLY CHAIN

A2.1 Loss of ability to sell forward

The loss of COCOBOD's ability to sell forward appears a remote threat. However, it is mentioned due to the fact that any loss would have a seismic effect on the Ghanaian cocoa sector. The entire fixed farmer price system is predicated upon CMC's ability to sell cocoa forward. These forward contracts are effectively leveraged as collateral that enables COCOBOD to borrow the funds from an international syndicate. The resulting funds are used to finance the purchase and evacuation of cocoa. If this facility were withdrawn due to, for example, a reduction in global liquidity, the current system would have to be immediately restructured, or financing would have to be secured internally. This threat, however, seems especially remote given COCOBOD's ability to maintain financing through the global liquidity crisis in 2008 and 2009. The downgrading of Ghanaian government debt or a significant financial loss to COCOBOD could also precipitate a reduction in the loan size or an increase to the relative price of funding to COCOBOD. In addition, myriad risks mentioned elsewhere in this document could potentially impact COCOBOD profitability, and by extension, its ability to attract financing.

A2.2 Invasive species

This description includes the "known unknowns" that threaten cocoa production in other continents. The two genera described below are considered the diseases and insects that pose the greatest external threat to cocoa in West Africa. The possibility of their introduction--via accidental introduction, bioterrorism, or spread from adjacent countries--must not be ignored.

A2.2.1 The *Moniliophthora* diseases

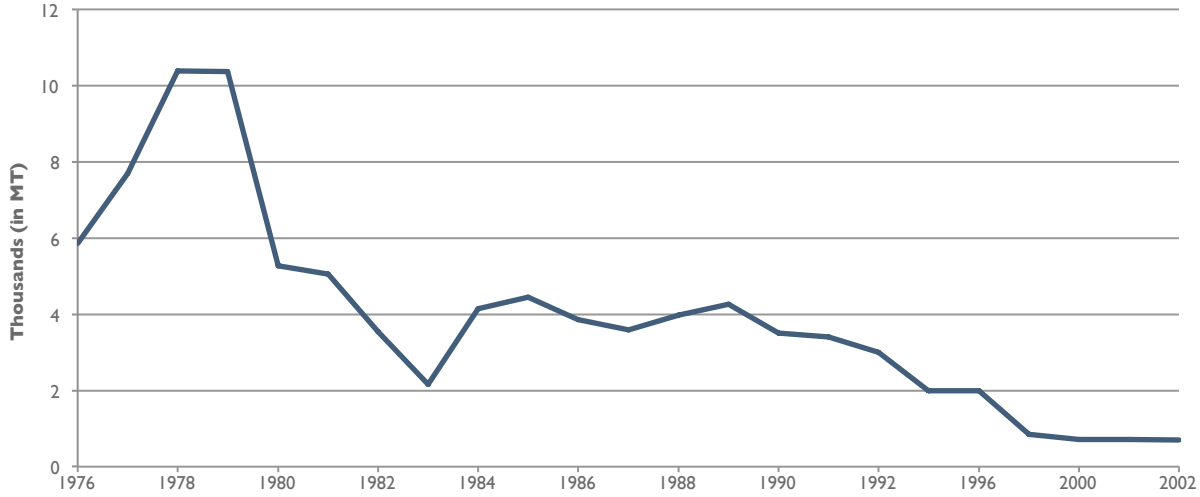
Two congeneric, South American diseases are considered as potential invasive threats to cocoa production in other continents: witches' broom and the less well known, but at least equally pernicious, frosty pod rot.

A2.2.1.1 Frosty Pod Rot (FPR) - FPR is caused by *Moniliophthora roreri*. It is a highly invasive species, with records of spread up the isthmus of Panama (1956), followed by Costa Rica (1978), Nicaragua (1979), Honduras (1997), Guatemala (2002), Belize (2004), and Mexico (2005), where it threatens ancient cocoa germplasm (Philips-Mora et al., 2006). Figure A2.1 illustrates decline in Costa Rican cocoa production after 1978, illustrating the effect it might have in the decades following an outbreak (though subsequent socioeconomic and other factors also played a role). Its impact on West African production in the event of an outbreak would be catastrophic and would easily supercede all other diseases such as black pod and witches' broom in terms of crop losses.

The main method for management of FPR is crop sanitation, involving regular removal of infected pods (that requires recognition of the early symptoms); sprays of copper fungicides also provide limited benefits. As the spores can move long distances, disease pressure will remain high unless sanitation efforts are coordinated on a regional scale. There may be limited scope for host plant resistance, but only a very limited number of genotypes appear to exhibit tolerance to the disease.

A2.2.1.2 Witches' Broom (WB) - *Moniliophthora perniciosa* is currently limited to South America, Panama, and the Caribbean, and is perhaps the oldest and best-known cocoa disease, thought to have co-evolved with cocoa in its center of origin (first recorded in the Brazilian Amazon in 1785). In 1989, it was introduced to the cocoa producing state of Bahia; output diminished from 380,000 tons *per annum* to 90,000 tons in the late 1990s. In less than a decade, Brazil went from being the world's second largest cocoa producer to becoming a net importer. Were this disease to be introduced into West Africa, cocoa production might well be more than halved and the effect to farmers' livelihoods potentially devastating (unless or until there was a substantial rise in FOB prices). Unlike frosty pod rot, which is highly infectious but mostly destructive to pods, witches' broom can infect many sites on actively growing trees, throughout the growing season, and in severe cases can cause tree death.

FIGURE A2.1 - COCOA BEAN PRODUCTION IN COSTA RICA (1976-1998)



SOURCE: ICCO, 2005

A2.3 Cocoa Pod Borer (CPB)

Cocoa pod borer (*Conopomorpha cramerella*) is considered to be one of the most serious cocoa pests in South East Asia since it not only causes crop loss (in some instances, yield loss can reach about 80%) but also greatly reduces cocoa quality. The spread of this invasive pest species was a major setback for Malaysian cocoa production, contributing to its decline in the 1990s. Its presence had previously been confirmed in Java (1895), the Philippines (1936) and, probably since 2006, in Papua New Guinea where the outbreak was treated as a national emergency.

Measures to restrict the movement of pods from infested areas are important, while monitoring is also crucial for detecting early outbreaks as it increases the prospects for eradication. Pod sleeving with plastic bags reduces invasion of pods by CPB and a reduction of damaged pods from 80% to 1% has been reported. The most effective reductions in CPB are likely to come through application of cultural control, especially regular complete harvesting. This relies on the maintenance of well-pruned trees kept to a height low enough to allow the collection of all pods as soon as they ripen, but with labor shortages this control method can be problematic.

A2.4 Other potentially threatening species

In addition to the above, there are a number of other species that pose a potential threat to the cocoa sector in Ghana. These include:

- Vascular streak die-back (VSD) - VSD causes characteristic staining of vascular bundles, mottling of leaves and "saw-tooth" leaf lesions. When these symptoms are found at an early stage in mature trees, hard pruning well beyond the infected parts of a branch and destruction (preferably burning) of removed plant material may be effective. There is some scope for host plant resistance; fungicides are rarely cost effective for wide-scale spraying of mature trees, and are used mostly for protecting seedlings.
- Root diseases - Fungal diseases in the soil, such as *Ceratocystis fimbriata*, can cause relatively sudden tree death. Ceratocystis wilt of cacao, caused by a host-specialized form of the fungus, has been locally important in Latin America, where it is believed native and has been associated with drought, when South Bahia experienced reduced rainfall.
- Various exotic sucking and boring insect pests of many species. [15]

[15] Entwistle 1972, *ibid.*

A2.5 'Dutch' disease and real appreciation of Ghanaian Cedi

As Ghana moves from a Cocoa economy to an oil economy, there is a high risk of marginalization of the cocoa sector and appreciation of exchange rate, resulting from large inflow of foreign exchange earnings. Unless the oil revenues and the exchange rate is managed well, Cedi might appreciate substantially resulting in reduced real income for the cocoa farmers. If this were to happen, it might create disincentives for cocoa farmers and might have implications on cocoa production. Management of this potential risk will require investments to increase productivity, changes in marketing structures to further increase farmer's share of the FOB prices, prudent macro-economic policies, effective management of exchange rate, and continued investments in the agriculture sector.

A2.6 Climate change

Concerns of climate change rendering large tracts of current cocoa growing area unsuitable for cultivation was articulated by many stakeholders as a potential threat that could severely impact cocoa production in Ghana. Based on current climate data and future climate change simulation models, a recent study by the Centre for Tropical Agriculture (CIAT) predicted that by 2030, the yearly minimum and maximum temperature will increase leading to a decrease in current cocoa growing area. However, while climatic suitability for cocoa will decrease seriously in the west side of western region of Ghana and west and south of Brong Ahafo, on the other hand, area around mountain ranges in Ghana (Kwahu plateu, between eastern and Ashanti region) will remain climatically suitable till 2050. Southern parts of the western region will gain in cocoa suitability by 2050 (CIAT 2011). Considering the site-specificity of the potential impact of climate change, in some areas farmers will need to identify alternate crops while in other areas farmers will need to adapt their agronomic management to evolving conditions.

ANNEX A3 - COCOA SUPPLY CHAIN CONSTRAINTS

In addition to risks, cocoa supply chain stakeholders in Ghana face a number of constraints. While the current assessment focused on identifying risks, the team also took note of some key constraints that can hamper the ability of various actors to allocate their resources efficiently and maximize their return on their investments. Such constraints can also amplify levels of risk exposure and the losses incurred by stakeholders when risk events occur. Chief among these constraints are the following:

- **Low farm productivity -** Smallholder cocoa farmers in Ghana are among the least productive anywhere in the world. Average yields have been declining and remain well below that of other major cocoa producers such as Cote d'Ivoire and Indonesia. Low rates of fertilizer use is the biggest factor explaining Ghana's low productivity. Other factors include aging tree stock, aging farmers, and poor tree husbandry. Low yields translate to less income for farmers to reinvest in their farms.
- **Insufficient access to affordable credit -** The vast majority of cocoa farmers in Ghana are at subsistence level and have limited working capital for the purchase of needed inputs and to cover intra-seasonal household needs. Asset-poor and isolated, few can get a loan, and the ones that can, face exorbitant interest rates from financial institutions that view farmers as high risk. Processors, exporters, and traders can also have difficulty getting access to needed working capital loans, which decreases their turnover and income potential. According to a recent study by Association of Ghana Industries, poor availability and the high costs of credit constitute the single largest constraint to growth in Ghana.[16]
- **Limited access to affordable, timely inputs -** Cocoa farmers in Ghana have a difficult time in procuring fertilizers, fungicides, pesticides, and other inputs that would otherwise help to increase their yields and reduce losses to pests and diseases. Only 14% of farmers in a recent survey[17] reported having ready access to fertilizers when they needed them, for example. In addition to frequent lack of market availability, the high cost of inputs often places them out of reach for most farmers.
- **Weak extension support -** The majority of farmers interviewed during consultations reported having limited to no access to technical extension services. While some farmers have benefited from donor and Public Private Partnership programs, many did not know where to go for help with problems they were facing on their farms.
- **Weak organizational capacity -** Among cocoa farmers in Ghana, less than 10% are members of a cooperative or other farmer association. This limits their ability to benefit from a number of typical advantages offered by farmer grouping such as volume purchasing of inputs, shared labor, and credit saving schemes. Related to this are low literacy rates among rural farming communities throughout Ghana that hinder farmers' capacity to manage their limited resources more effectively.
- **Insecure land tenure -** Existing land tenure systems typically fail to provide sufficient security in land titling among the majority smallholder cocoa farmers in Ghana. This constrains their ability to use their land holding as collateral to access financing to invest in their production and improve their land utilization. In addition, competition over land and legal pluralism stemming from multiple land tenure systems can create confusion and act as a further disincentive for farmers to invest in their land.
- **Insufficient availability of raw materials for processing -** Local processors are unable to procure adequate quantities of affordable cocoa beans, which prevents them from operating at full capacity and decreases the viability of local value-added opportunities.

[16] See Business Barometer, 1st Quarter 2010, Association of Ghana Industries, 13 May 2010.
[17] Hainmueller et al., 2011.

ANNEX A4 - COCOBOD HIGH TECH PROGRAM

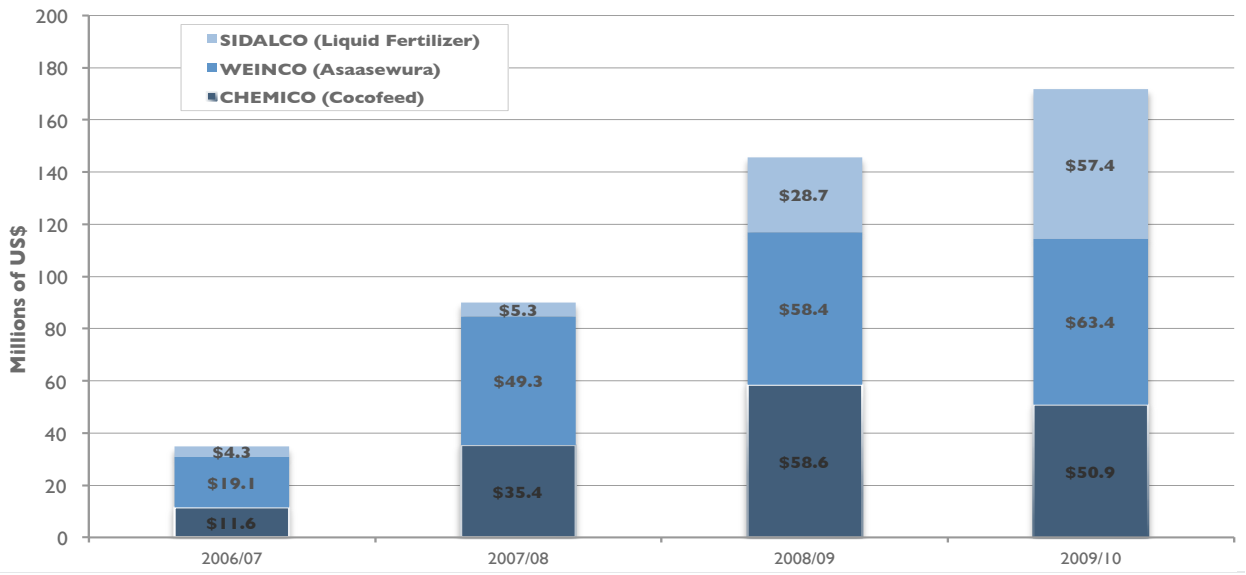
Low soil fertility has been identified as a major cause of decline in yield of cocoa farms in Ghana. In 2010, approximately 200,000 of the estimated 2 million hectares (4.9 million acres) of cocoa plantations in Ghana were effectively treated with fertilizer. COCOBOD hopes to increase this to between 300,000 and 400,000 hectares in the coming year.

Since 2003, COCOBOD's "High Tech" program has been making subsidized fertilizers and training in rationale application and use available to farmers. COCOBOD launched the program in line with its overall strategy to improve soil fertility and raise productivity. COCOBOD procures two types of granular fertilizers and one liquid fertilizer approved and certified by CRIG from three local input suppliers: CHEMICO, WEINCO, and SIDALCO. The fertilizers are made available to farmers for purchase primarily through LBCs, private distribution networks, and the Ministry of Food and Agriculture (MOFA) district offices. COCOBOD's subsidy covers roughly 48% of the market price. The fertilizers are marked "not for sale" and it is illegal to sell them in the open market at a nonsubsidized price. Figure A4.1 illustrates the US$ value of subsidized fertilizers distributed in recent years. In 2009/10, the program purchased 2.6 million bags of granular fertilizer and 2 million liters of liquid fertilizers at a total cost of US$171.7 million.

There is general agreement that fertilizer applications of at least two bags per acre (309 kg/ha/year) are highly cost effective. The timing of fertilizer application is critical, and should ideally coincide with the first rains at the start of the rainy season (i.e., approximately May-June). Based on input from farmers, this appears rarely to be the case with the subsidized fertilizers distributed through COCOBOD's High Tech program. Late availability represents a significant opportunity costs by reducing possible yield gains. Despite the subsidies, some farmers perceived the expense of fertilizer usage, including the labor for application, to be too high.

A number of trials carried out by CRIG and its collaborators have established that, whereas poor results are obtained from inputs of nitrogen, fertilizers based on phosphorus and potassium achieve good yield returns. One 4 year study of fertilizer use on smallholder farms (using 129 kg P205 and 76.5 kg K2O per hectare per year) found that fertilized plots on all the farms showed an increase in yield over the unfertilized plots by 62% in the 1st year; 100% in the 2nd year; 116% in the 3rd year; and 106% in the 4th year. By the end of the 4th year, 75% of the fertilized farms had yields more than 1000 kg/ha.

FIGURE A4.1 - FERTILIZER PURCHASES FOR 'HIGH TECH' PROGRAM



SOURCE: COCOBOD Annual Reports

ANNEX A5 - CODAPEC OPERATIONS

CODAPEC administers the national campaign against black pod disease and mirids. Its program typically follows an annual action plan, as depicted in Table A5.1.

TABLE A5.1 - CODAPEC ACTION PLAN, 2010

ACTIVITY	J	F	M	A	M	J	J	A	S	O	N	D
Budget and establishment of Letters of Credit												
Appraisal and Review of 2010 Program												
Inspection of storage facilities in the district centers												
Servicing and repairs of spraying machines												
Medical examination for selecting gang members												
Farmers' fora, publicity and educational campaign												
Inspection and certification of inputs supplied												
Meeting with district taks forces to ascertain state of preparedness												
Listing fo inputs to district and unit centers for1st fungicide application												
Preparations for 2012 budgets												
First application of fungicides												
Field visit to task forces: assess and review 1st fungicide application												
Lifting of inputs to district and unit centers for 1st insecticide application												
Submission of situtation reports on 1st fungicide application												
Distribution of fungicides to district and unit centers for 2nd fungicide application												
Second application of fungicides												
First application of insecticides												
Situation report on 1st insecticide application												
Assessment and review of 2nd funficide application												
Distributon of fungicides for 3rd application												
Distribution, application and assessment of 2nd insecticide application												
Third fungicide application												
Evaluation by independent committee (CRIG)												
Final technical report on year's Program												

SOURCE: CODAPEC Annual Report 2010

Table A5.2 shows estimates of infected areas that might require cutting down and replanting, based on CSSVDCU's control formula. In severe cases, this can easily translate into a substantial proportion of a smallholder's farm.

TABLE A5.2 - CSSVDCU CONTROL FORMULA

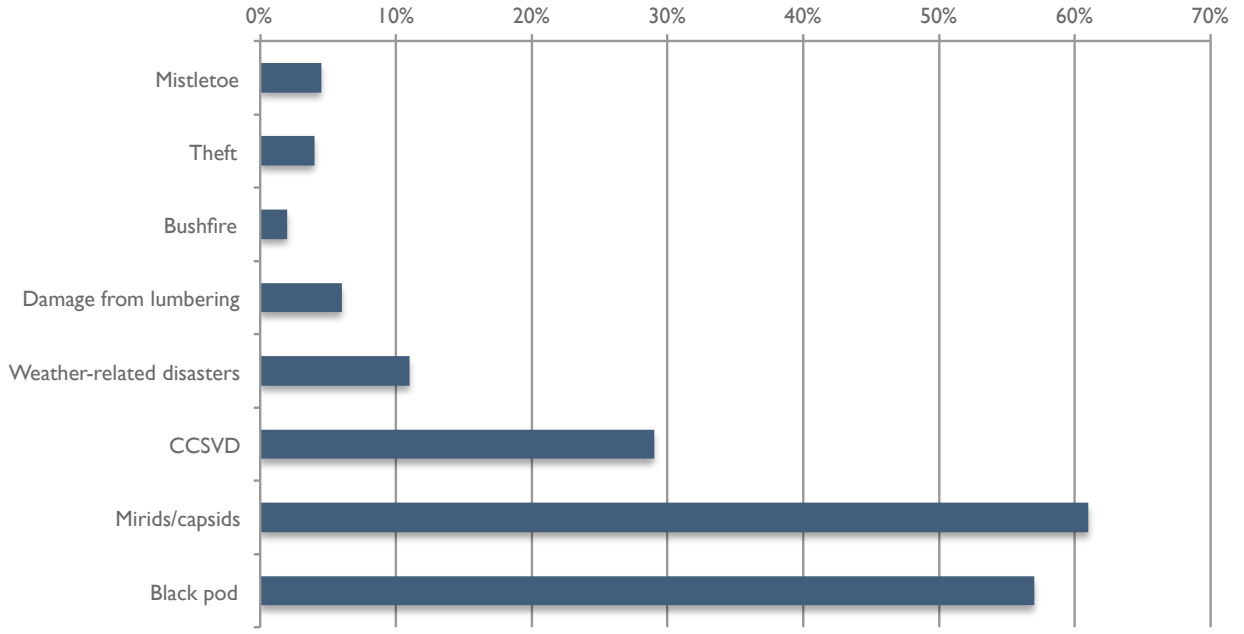
Observed Infection	Removal	# of trees removed	Ha replanted*
1-4 trees	trees, plus contact trees	9	0.01
Several trees	5m surrounding infection	49	0.05
60 trees or more	10m surrounding infection	196	0.18
100 trees or more	15m surrounding infection	400	0.36-1.67

SOURCE: Interview with Deputy Executive Director, Dr. George Opoku, May 2011
* Based on a 3x3 meter tree spacing in rows; infected foci and surrounding trees

ANNEX A6 - FARMERS' RISK PERCEPTION

In a 2010 baseline survey of approximately 3000 cocoa farmers in Ghana, respondents were asked to cite what problems they had encountered in the last 12 months. Responses are depicted in Table A6.1 and illustrate that productivity among the majority of farmers is hampered by significant problems with crop disease and pests (Hainmueller et al., 2011).

TABLE A6.1 - COMMON THREATS TO COCOA CROP



SOURCE: Hainmueller et al., 2011

ANNEX A7 - LIST OF STAKEHOLDERS INTERVIEWED

NAME OF ORGANIZATION	ORGANIZATION TYPE	LOCATION
Thursday, 27 May 2011		
Wienco Ghana Limited Marc Kok, Managing Director	Input wholesaler	Accra, Accra Metropolitan District
Cocoa Marketing Company Jacob Dep, Managing Director, Marketing	COCOBOD	Accra, Accra Metropolitan District
Quality Control Division George Okyere, Quality Control Manager	COCOBOD	Accra, Accra Metropolitan District
Technoserve, Inc. Nicolas Ralston-Brown, Country Director	NGO	Accra, Accra Metropolitan District
Cadbury Foundation	PPP	Tema, Tema Municipal District
Global Haulage	Transport Service Providers	Tema, Tema Municipal District
CCSVDCU	COCOBOD	Accra, Accra Metropolitan District
Friday, 28 May, 2011		
Cocoa Processing Company Tim Essandoh, Dep. Managing Director, F&A	Processor	Tema, Tema Municipal District
Cargill Ghana Limited Kojo Amoo-Gottfried, Managing Director	Processor	Tema, Tema Municipal District
Armajaro Ghana Limited Nelson Kpodo-Tay, Director of Operations	LBC	Accra, Accra Metropolitan District
Agriculture Development Bank Henry Shirazu, Policy and Strategy Implementation Coordinator	Bank	Accra, Accra Metropolitan District
Produce Buying Company (PBC)	LBC	Accra, Accra Metropolitan District
Yara Mehdi Saint Andre, Managing Director	Input wholesaler	Accra, Accra Metropolitan District
National Cocoa Disease and Pest Control	COCOBOD	Accra, Accra Metropolitan District
Monday, 30 May 2011		
Federated Commodities, Head of Operations	LBC	Kumasi, Kumasi Metropolitan District
Association of Licensed Buying Companies	Trade Association	Kumasi, Kumasi Metropolitan District
Cocoa Merchants Co. Ltd. Nana Amo Adada Boamah, Managing Director	LBC	Kumasi, Kumasi Metropolitan District
Olam International Eric Botwe, Head of Operations	LBC	Kumasi Kumasi Metropolitan District
Kuapa Koko Kwasi Aduse-Poku, Managing Director	LBC	Kumasi Kumasi Metropolitan District
Cocoa Research Institute of Ghana (CRIG) Executive Director and other research teams	Research Institute	Tafo
Tuesday, 31 May 2011		
CMC, Kumasi Take-Over Centre George Oklu, Ag. Area Coordinator	COCOBOD	Kaase, Kumasi Metropolitan District

NAME OF ORGANIZATION	ORGANIZATION TYPE	LOCATION
Group of truck drivers	Transport Service Providers	Kaase, Kumasi Metropolitan District
Quality Control Company	COCOBOD	Nyinahin District
Farming community	Farmers	Antuma, Nyinahin District
Quality Control Company	COCOBOD	Bekwai District
Farming community	Farmers	Adansi North District
Akuafo Adamfo Theophilus Agyare Asare, GM Operations	LBC	Kumasi, Kumasi Metropolitan District
ADM	Processor	Kumasi, Kumasi Metropolitan District
LBC Agent	FEDCO (LBC) Agent	Sefwi Asawinso District
Farming Community	Farmers	Beposo village, Sefwi Asawinso District
Wednesday, 1 June 2011		
Quality Control Division	COCOBOD	Nsokote, Adansi North District
Farming Community	Farmers	Adansi North District
Cocoa Inputs Company	Input supplier	Nsokote, Adansi North District
Quality Control Company	COCOBOD	Bekwi District
Farming community	Farmers	Bekwi District
Farming community	Farmers	Adjoepur, Bia District
Farming community	Farmers	Kukumsu, Bia District
Extension agent	COBOBOD	Bia District
Input supplier	Input supplier	Bia District
Thursday, 2 June 2011		
Quality Control Company	COCOBOD	Akasi District
Farming community	Farmers	Akasi District
Quality Control Company	COCOBOD	Akim Ofaose
Purchasing Buying Company Martin Adjikum, Purchasing Clerk	LBC	Chiau, Akim Ofaose District
Farming community	Farmers	Chiau, Akim Ofaose District
Farming community	Farmers	Nyame Bekyere, Sankora/Kukuom District
Farming community	Farmers	
CODEPAC officer and district Chief farmer	COBOBOD	Kukuom District
Input supplier	Input supplier	Kukuom District
Friday, 3 June 2011		
Seed Processing Unit Afua Adama, Director	COCOBOD	Akwadum, Oyakem District
Cocoa Swollen Shoot Virus Disease Control Unit Francis Assid	COCOBOD	Kade, Kwaebibrem District

NAME OF ORGANIZATION	ORGANIZATION TYPE	LOCATION
COCOBOD Extension	COCOBOD	Kade, Kwaebibirem District
CODAPEC	COCOBOD	Kade, Kwaebibirem District
Maranatha Agrochemicals	Input supplier	Kade, Kwaebibirem District
Purchasing Buying Company Mr. Dente	LBC	Ekoso District
Baso Agro Business Ltd	Input dealer	Suynani District
Farming community	Farmers	Akwamu, Doma East District
Farming community	Farmers	Aajacoja, Mankaraso District
Saturday, 4 June 2011		
COCOBOD District Office Charles Jamfi, Officer in Charge	COCOBOD	Kibi, Kibi District
God is One Agrochemicals Ibrahim Ajyei	Input supplier	Kibi, Kibi District
George Adu-Pari	Seed/tree nursery owner	Odumasi-Akim, Kibi District
Dora Gyadu	Seed/tree nursery owner	Odumasi-Akim, Kibi District
Kuapa Koko George Adu Pari, Purchasing Clerks	LBC	Odumasi-Akim, Kibi District
Farming community	Farmers	New Kofurdia, Ajusa Waviri District
Monday, 6 June 2011		
Cocoa Marketing Company Joe Forson, Dep. Marketing Manager	COCOBOD	Accra, Accra Metropolitan District
COCOBOD Executive Secretariat	COCOBOD	Accra, Accra Metropolitan District
International Institute of Tropical Agriculture (IITA)	Research Institute	Accra, Accra Metropolitan District
Wrap-up meeting at COCOBOD Office	COCOBOD Officials	Accra, Accra Metropolitan District
Tuesday, 7 June 2011		
Cocoa Marketing Company, Port of Tema	COCOBOD	Tema, Tema Municipal District
Barry Callebaut Loic Biardeau, Managing Director	Processor	Tema, Tema Municipal District
Shashidhara Kolavalli, Senior Research Fellow	IFPRI	Accra, Accra Metropolitan District

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Agriculture and Rural Development (ARD)
1818 H Street, NW
Washington, D.C. 20433 USA
Telephone: 202-477-1000
Internet: www.worldbank.org/ard

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