Incentives for smallholders to enhance the production of quality cocoa beans in Ghana: the role of institutions

William Quarmine

Thesis committee

Promotors
Prof. Dr Arnold van Huis
Personal chair at the Laboratory of Entomology
Wageningen University

Prof. Dr Daniel Obeng-Ofori
Professor of Agricultural Entomology
University of Ghana, Accra, Ghana

Prof. Dr Felix A. Asante
Director, Institute Statistical Social and Economic Research
University of Ghana, Accra, Ghana

Co-promotor
Dr Rein Haagsma,
Assistant professor, Development Economics Group
Wageningen University

Other members
Prof. Dr Janice Jiggins, Wageningen University
Prof. Dr Paul C. Struik, Wageningen University
Prof. Dr David Millar, University of Development Studies, Bolgatanga, Ghana
Prof. Dr William K. Asenso-Okyere, International Food Policy Research Institute Accra, Ghana

This research was conducted under the auspices of the Wageningen School of Social Sciences (WASS).

Incentives for smallholders to enhance the production of quality cocoa beans in Ghana: the role of institutions

William Quarmine

Thesis

submitted in fulfillment of the requirements for the degree of doctor
at Wageningen University
by the authority of the Rector Magnificus
Prof. Dr M.J. Kropff,
in the presence of the
Thesis Committee appointed by the Academic Board
to be defended in public
on Thursday 12th December 2013
at 11 a.m. in the Great Hall of the University of Ghana.

William Quarmine
Incentives for smallholders to enhance the production of quality cocoa beans in Ghana: the role of institutions
166 pages.

PhD thesis, Wageningen University, Wageningen, NL (2013)
With references, with summaries in Dutch and English

ISBN: 978-94-6173-808-0

To:

Mr. Ezekiel Narh-Odonkor and family
Dr. Rein Haagsma and family
Dr. Owuraku Sakyi-Dawson

Acknowledgements

This thesis is credited to my name but, in reality, it is the product of the collective effort of many people from diverse backgrounds. I am indebted to all of them for bringing me a step closer to my childhood dream of becoming a Ghanaian academic.

In 2008, I almost convinced myself that I had no future in academia. I am grateful that Dr. Owuraku Sakyi-Dawson, my mentor, convinced me not to give up and to compete for places in the PhD programme 'Convergence of Sciences - Strengthening Innovation systems' (COS-SIS).

A special word of thanks must go to my four supervisors. In alphabetical order, Arnold van Huis, Daniel Obeng Ofori, Felix Asante and Rein Haagsma. Supervising a student like me can be hard work, but they did not give up on me. Rein, in particular, did a fantastic job at clarifying my thoughts and getting me to deliver. Felix seamlessly blended critical analyses of my work and words of encouragement. Daniel visited my field site, looked critically at my data and gave sound and key scientific input. Arnold would read my work faster than any one and provided critical input, which went a long way to improve the chapters.

A PhD of this nature requires a lot of field assistance from several people who deserve much appreciation. Richard Adu-Acheampong, entomologist at the Cocoa Research Institute of Ghana was the Research Associate (postdoc) of the cocoa domain of the CoS-SIS programme in Ghana. He opened several windows of opportunity for me, in order to obtain data, for which I am grateful. Felix Awu of the Ministry of Food and Agriculture, Suhum, was instrumental in setting up and managing all my field experiments.

Of course, I was assisted by many other people who either joined my experiments or were survey respondents. These included farmers; officers of Cocoa Board; and Licensed Buying Companies, staff of Cocoa Research Institute across the country. I appreciate every little help they offered me.

This PhD path was costly and could not have been possible without the financial support from the COS-SIS Program. Special mention must be made of the fruitful interaction I had with the large COS-SIS community throughout these last four years. Especially from Prof. Niels Röling, Prof. Janice Jiggins, and Dr. Dominique Hounkounou. To my colleagues of the COS-SIS program - Charity Osei-Amponsah, Euloge Kodjo Togbe, Essegbemon Akpo, Kwadwo Amankwah, Rolland Yemadje, Edmond Totin, Nathalie Kpera, Amadou Sidibé – you guys are the best.

I am thankful to Prof. Erwin Bulte as well as staff and colleague students of the Development Economics Group of Wageningen University. I will miss the tea sessions.

My family deserves a lot of appreciation for their support throughout this process. I reserve a special place for Mr. Ezekiel Narh-Odonkor and his family for helping to lighten my burns throughout this PhD program. Fred Kuffuour and Annika Rulkens became my new family in the Netherlands. When things get too complicated for me, they will take me on trips around Netherlands and Germany. I am most grateful to them, especially for the Dutch Summary.

Table of contents

List of tables

List of figures

Chapter 1

General Introduction

1.1 Introduction

Growing consumer concerns about food safety have put pressure on agricultural commodity markets to pay more attention to produce quality (Auriol and Schilizzi, 2003). Commodity quality assurance begins at the farm, where smallholders continuously make production decisions that influence food safety. Cocoa is Ghana's most important agricultural commodity and cocoa beans exported from Ghana are known for their consistent quality. However, at farm level, there is evidence to suggest that farmers, mainly smallholders, can do more to enhance the quality of their produce (Laven et al., 2007, Osei, 2007). Most policy and programme effort to get smallholders to enhance the production of quality commodities like cocoa have focused on development and transfer of agricultural technologies (Röling, 2009). This approach does not always yield the desired outcomes because it disregards institutional factors that often inhibit uptake of technologies by smallholders (Hounkonnou et al., 2012).

This thesis argues that the adoption, by farmers, of quality-enhancing technologies is hampered by the rules (or institutions) that govern interactions in the internal cocoa market of Ghana. The argument is presented in five empirical chapters that are divided into two parts (Figure 1.4). The first part (Chapter 2 and 3) provides a general background and demonstrates how market-related institutions influence farmer behaviour. The second part (Chapter 4 to 6) experiments with alternative institutional mechanisms that might nudge smallholders to consistently supply quality cocoa beans. In this introductory chapter, the process of problem identification, relevant gaps in literature, research objectives, and methods of analyses are discussed. At the end, the structure of the thesis is presented.

1.2 Study Context

1.2.1 Cocoa production in Ghana

Cocoa (*Theobroma cacao L.*) is a perennial tree crop that thrives well in humid tropical forest conditions. Typically, a cocoa tree has an average economic life of 25-30 years. The tree bears an ovoid fruit of about 15–30 cm long and 8–10 cm wide. Each cocoa pod contains between 20 and 60 seeds (referred to as cocoa beans throughout this thesis) from which cocoa butter and other chocolate base products are

extracted (Wood and Lass, 2008). In Ghana, the crop grows over two seasons – the main crop (October to June) and the minor crop (July to September). Cocoa beans produced in the main crop season are bigger in size (Baker et al.,1994). After the tree is planted, farmers must carry out a number of cultural practices to maintain the fertility of the soil, prevent pests, manage diseases, and control shade conditions for effective yield. On harvest, pods must be carefully broken to extract the cocoa beans. The beans must then be fermented for about 6 days, dried and polished before they can be sold (Anim-Kwapong et al., 2007).

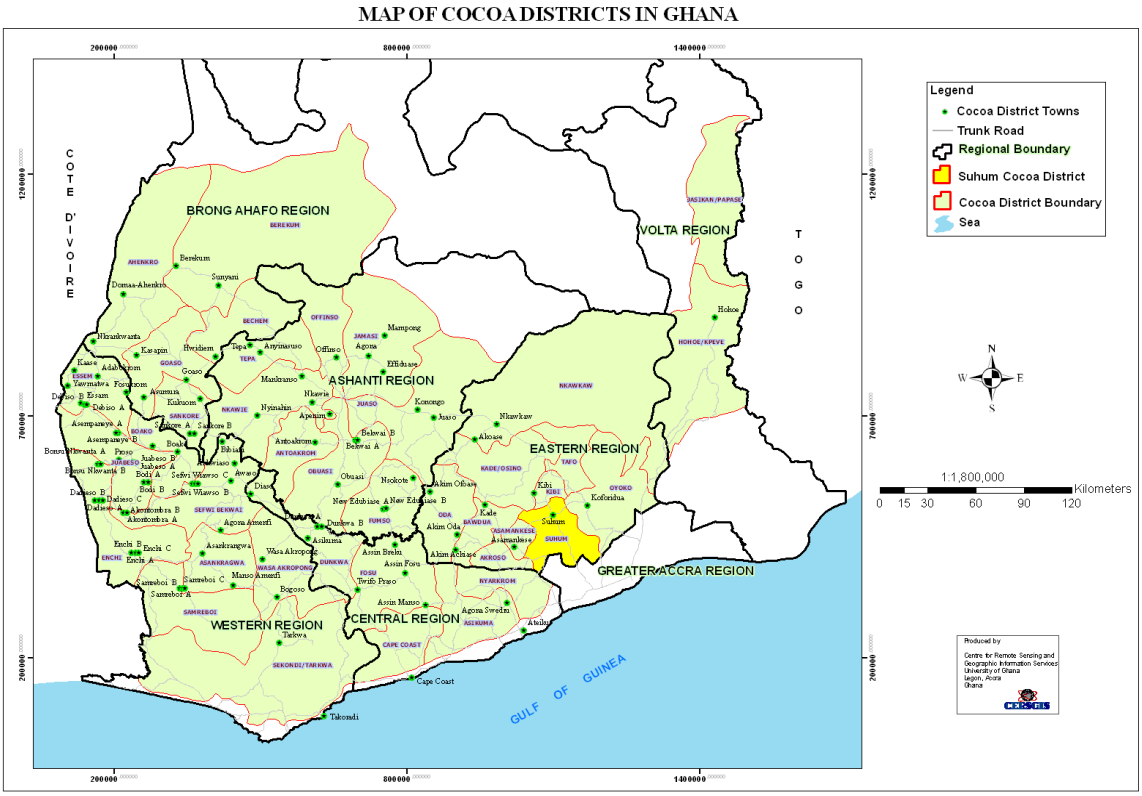

Figure 1.1 Map of southern Ghana showing the cocoa belt

Cocoa was introduced into Ghana two centuries ago by Dutch Missionaries (Acquaah, 1999). Commercial production is however believed to have begun when Ghanaian farmer Tetteh Quarshie returned from Fernando Po (now Bioko in Equatorial Guinea) with some cocoa pods in 1897 and started a commercial farm (Anthonio and Aikins, 2009). Since then, the crop has expanded throughout southern Ghana and has become Ghana's main agricultural export commodity (Hill, 1997). Figure 1.1 shows a map of southern Ghana depicting the cocoa-growing belt, which is marked in green. Cocoa is mainly cultivated by smallholder farmers in six of the ten administrative regions in Ghana that have forest agro-ecological conditions. These are the Ashanti, Brong-Ahafo, Central, Eastern, Western, and the Volta Region.

Cocoa is one of Ghana's most important national export commodities (Anang, 2011). The crop's contribution to Ghana's economy in terms of trade balance, employment, infrastructure, as well as social services like education and health, is considerable (Leiter and Harding, 2004; Williams, 2009; Vigneri, 2007). At the national level, cocoa drives Ghana's trade balance by contributing over 20% of the total annual export revenue (Figure 1.2). Taxes on cocoa exports have been a major source of government revenue since independence (Breisinger et al., 2011). In addition, revenues from cocoa have been used to fund several infrastructural goals of the state such as schools, hospitals and road networks. At the household level, cocoa provides a means of livelihood for over six million households comprising farmers, farmhands, produce buyers, processors, haulers, researchers, and staff of COCOBOD (Kolavalli et al., 2012).[1]

Ghana's cocoa sector has been described as an African success story because over the years, the country has sustained its status as one of the worlds' leading suppliers of the crop (Williams, 2009). From early 1911 to 1960, Ghana became the leading supplier of cocoa beans, exporting up to 40% of the total world output. A general economic decline, unstable real producer prices, excessive taxation, and political instability resulted in lowered producer incentives and hence a decline in production. Consequently, beginning from 1960, Ghana's share in the total world output declined from 35% to about 15% in 2011 (Figure 1.3).

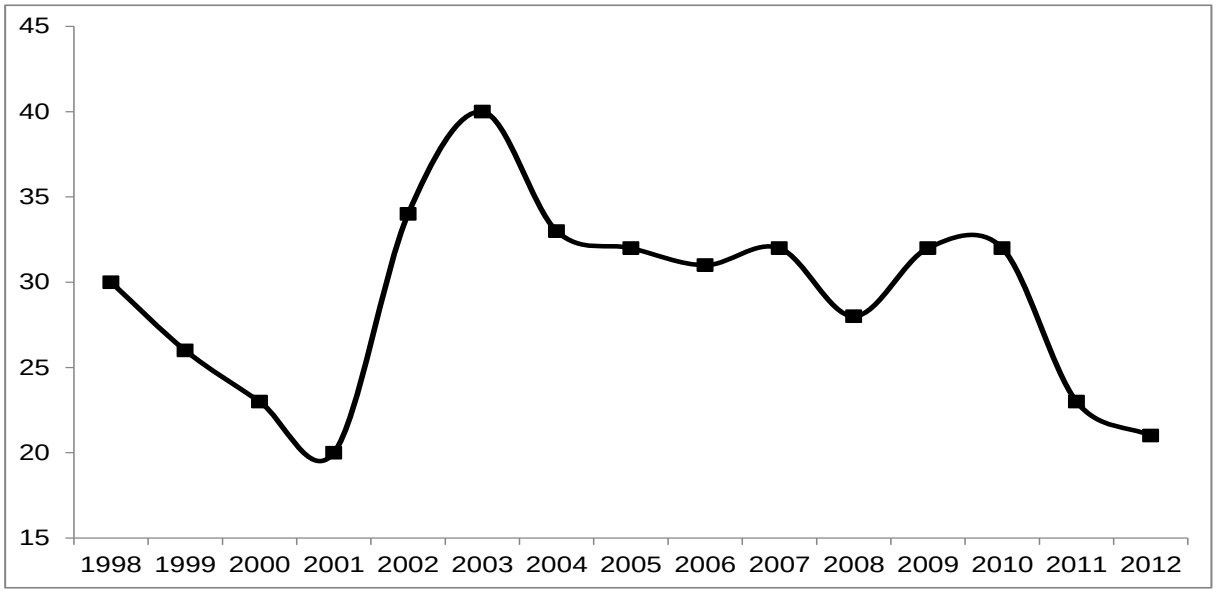

Figure 1.2 Trends in percentage contribution of cocoa to export revenue, 1988-2012

Source: Bank of Ghana (2012)

[1] Throughout this thesis, COCOBOD refers to Ghana Cocoa Board, the state marketing board that coordinates all activities of Ghana's cocoa sector.

Beginning from 1984, a number of liberalization reforms were introduced into the cocoa sector with the objective of halting the decline in production. These reforms included restructuring of the oversight organization (COCOBOD), changes in extension structures, state-funded pest management programmes, replanting (or rehabilitation of old farms), and market and pricing reforms (Essegbey and Ofori-Gyamfi, 2012). With these reforms, Ghana witnessed a sharp increase in cocoa production from less than 300,000 metric tons in 1990 to the present annual average output of close to 1,000,000 metric tons. Another indicator of the success of Ghana's cocoa sector over the years is the consistent supply of the bulk of the world's best quality produce. Cocoa from all other origins is therefore measured against the standard of Ghana cocoa. Amoah (2008) notes that due to this consistent quality performance, cocoa beans from Ghana sell at a premium compared to produce from other countries. Kolavalli et al. (2012) suggests that Ghana earns a quality premium of about 5% more than other countries. This is said to constitute an average of US$ 200 – 250 per tonne over the prevailing international cocoa price (Barrientos et al., 2007).

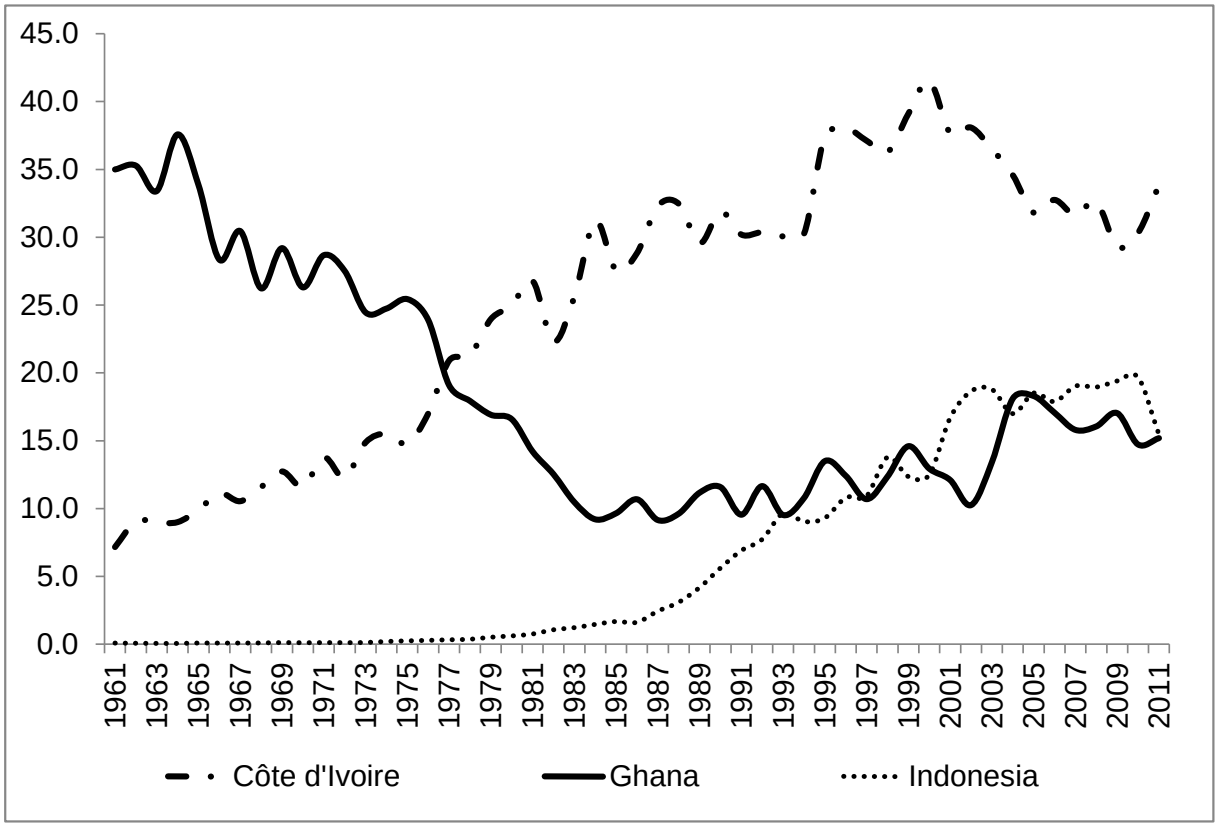

Figure 1.3 Share of Ivory Coast, Ghana and Indonesia in total world cocoa output, 1961-2011

Source: FAO

A number of studies have attributed this consistent performance in terms of output and quality to institutional factors (Essegbey and Ofori-Gyamfi, 2012; Knudsen and Fold, 2011; Kolavalli et al., 2012; Williams, 2009). Institutions here, and

throughout this study, refer to laws, regulations, policies, cultural norms, and organizations that shape human interactions (Eaton et al., 2008; Edquist, 1997; Nelson, 2008; North, 1990). For example, Leiter and Harding (2004) have mentioned that, throughout the 200 year history of cocoa in Ghana, successive governments have deliberately controlled the production and export of cocoa through implementation of a number of legal and political instruments.

Even though cocoa laws and policies have evolved over the years they have carried out similar functions. Essentially, cocoa laws and policies have been used to regulate production practices by farmers; the organization of cocoa trading in Ghana, including prices and export duties (taxes); the control of insect pests and management of diseases; and how quality is to be controlled.[2] In addition to the political institutional environment, mention has been made of the positive impact of several other institutional factors such as cooperative societies and producer networks (Cazzuffi and Moradi, 2010; Young et al., 1981), land tenure contract arrangements (Takane, 2002), and social norms like reciprocity, trust and inheritance systems (MacLean, 2010), which have all worked together to shape the cocoa sector of Ghana.

1.2.2 Why focus on quality?

Notwithstanding Ghana's strong performance, in recent years, the same institutional setting has placed a number of constraints on smallholder livelihoods. In the framework of the research programme "Convergence of Sciences – Strengthening Innovation Systems" (CoS-SIS), Dormon and Sakyi-Dawson (2009) conducted an exploratory study to identify some of these constraints for smallholder cocoa farmers.[3] The study concluded that: (1) the organization of the internal cocoa bean market does not provide incentives for farmers to supply higher volumes of quality cocoa beans; (2) farmers are not sufficiently organized to take advantage of the opportunities offered by high value niche markets, in particular those of organic produce; and (3) land tenure and land use contracts are often to the disadvantage of farmers. As a result, smallholders do not always meet their profitability goals (Dormon and Sakyi-Dawson, 2009).

[2] See Acquaah (1999) for a chronicle of the evolution of legal and political instruments that were used to coordinate the cocoa sector before liberalization reforms took place in 1984. Other authors have amply described post-liberalization institutions and their impacts (Amoah, 1998; Laven, 2010; Essegbey and Ofori-Gyamfi 2012; Kolavalli et al. 2012).

[3] The studies reported in this thesis were funded by the research programme "Convergence of Sciences –Strengthening Innovation Systems (CoS-SIS)". See Appendix for a summary of the CoS-SIS research programme. See also www.cos-sis.org.

These findings were discussed by a panel of experts made up of scientists, farmers, extension officers, and policy makers at a conference at Elmina in Ghana, in October 2009 (van Huis and Youdeowei, 2009). One of the objectives of the workshop was to prioritize key research concerns as identified by Dormon and Sakyi-Dawson (2009). Sustaining Ghana's premium cocoa quality position on the international cocoa market was, during this conference, considered critical for improving smallholder livelihoods (Aneani and Takrama, 2006). This is because, as a result of consistent export of quality cocoa beans, Ghana is able to sell about 70% of the produce in forward markets. The forward sale of cocoa beans ensures a fairly stable producer price regime. Therefore, when the quality of Ghanaian cocoa beans is compromised, farmers' economic position will likely be jeopardized. Additionally, resolving problems that undermine the production and export of cocoa bean quality is likely to address the other concerns identified by Dormon and Sakyi-Dawson (2009). Hence, an investigation of the institutional factors that tend to undermine Ghana's current premium quality reputation was prioritized at the workshop as an entry point for this thesis. This investigation was carried out in 2010 through a diagnostic study (Chapter 3).

1.3 Problem statement

1.3.1 Problems with production of quality cocoa beans

In Ghana, "quality cocoa" is defined as cocoa beans that are well fermented; of uniform size; and free from broken, smoky, and insect damaged beans. Additionally, cocoa beans must have a moisture content of maximum 7.5% and be free of foreign matters including insects (Mikkelsen, 2010). The first stage towards export of quality cocoa beans is the farm, where farmers must continuously enhance the quality of their produce and make sure the beans do not fall below certain minimum standards. A review of the recent cocoa literature points to a trend of concerns with the quality of cocoa beans produced by Ghanaian farmers. For instance, Laven et al. (2007) posits that average quality of cocoa beans produced in Ghana seems to have suffered a slight decline after the introduction of market liberalization policies in 1984. Hainmuller et al. (2011) project that about 34% of potential annual crop is lost to insect damage and disease. Kolavalli et al. (2012) explain that the problem with the quality of cocoa beans at the production level is caused by an increase in the proportion of purple beans, arising from poor harvest and post-harvest practices.[4]

[4] Cocoa of good quality has brownish cotyledons. Beans with purple cotyledons are called purple beans.

License cocoa buying companies (LBCs) therefore have to select good quality cocoa beans from the bulk purchased from farmers at their own cost before they can be sold up the supply chain. Williams (2009) indicates that rejection of low quality cocoa beans for the export market is common after the purchase from farmers. According to Osei (2007) there is a need to develop mechanisms against the rising cost of bean rejection and the overall quality control in Ghana. In Chapter 3 of this thesis, it is pointed out that, among other things, institutional factors, especially the organization of the cocoa market, give rise to a situation where farmers have more information about their production activities and hence the quality of their cocoa beans than LBCs. This asymmetric information problem arises because LBCs are typically unable to distinguish between farmers in terms of the grade of cocoa beans they supply. It explains why cocoa beans of all quality grades receive the same price from LBCs. The absence of pay-for-quality pricing, however, lowers the motivation of farmers to enhance the quality of their cocoa beans beyond current levels.

1.3.2 Theoretical perspectives

Institutions and asymmetric information

Under information asymmetry, average quality of produce declines. According to Akerlof (1970), institutions arise to counteract the negative effect of asymmetric information. By reducing the uncertainty surrounding technology use, costs of transactions and safeguarding property rights, institutions provide incentives for economic agents to behave in certain ways which are beneficial to them (Klein, 1996, Williamson, 2000). For instance institutions either lead buyers to directly obtain information or induce farmers to provide the information by themselves. This thesis draws on the New Institutional Economics (NIE) approach to analyse how institutions can address the problem of asymmetric information in the cocoa sector of Ghana.

The NIE framework operates at two levels of analysis: macro and micro. Institutions that operate at the macro level form the institutional environment (Menard and Shirley, 2005). The institutional environment encompasses a variety of concepts. Aspects of the institutional environment in agriculture include public quality standards, policies, governing organizations, extension structures, social networks, and the general legal and regulatory framework. At the institutional environment level, this thesis analyses the impact of extension approaches and the rules governing cocoa pricing on farmers' motivation to enhance the quality of their cocoa beans. At the micro level, NIE identifies specific institutions that govern the relationships among transacting agents (governance structures). Asymmetric information between buyers and farmers is a major source of transactions costs in agricultural markets. This is because when faced with asymmetric information, buyers and farmers have to spend

extra resources to distinguish opportunistic from non-opportunistic behaviour ex ante (Williamson, 1979). Economic agents therefore select governance structures that best minimizes their transactions cost.

Three categories of governance structures are discussed by Eaton et al. (2008) based on whether interactions among economic agents are governed solely by prices, authority (through integration of separate economic agents into a firm or organization), or a hybrid of both. First, spot markets that involve one-off trading between parties who are unknown to each other. Here price is the main governance mechanism. Second, hierarchies where up-chain actors vertically integrate with producers are identified. In hierarchies, the main governance mechanism is the use of authority. The third form of governance structure is the hybrid arrangement, which combines elements of both price and authority to coordinate interactions among agents (Eaton et al., 2008). In this thesis, two distinct governance structures are examined with respect to the incentives they provide for farmers to enhance the production of quality cocoa beans. One is certification, which is an example of a hybrid governance structure, and the other is price differentiation with a test-cum-fee option, which is more close to price governance.

Farmer education institutions

Farmers' knowledge about agricultural technology has been associated with adoption (Conley and Udry, 2010). However, there is debate about the best approach to improve farmer knowledge. A spectrum of farmer training methods that range from "top-down" technology transfer to more participatory approaches have been discussed in the literature (Black, 2000). The technology transfer approach has been criticized for not being demand driven and hence failing to meet the needs and opportunities of farmers. Also, the indigenous knowledge, skills and adaptive capacities of farmers are ignored in the development and transfer of technologies under this approach. Recent discourse on extension assumes that farmers learn better if they are involved in the creation of knowledge. Hence, participatory technology development methods that are inclusive and demand-driven have been demonstrated to have positive impacts on farmers' knowledge (Dalton et al., 2011).

Cocoa extension in Ghana has evolved from a state-run structure that focused on commodity development and service delivery to a public-private sponsored system that concentrates on assisting farmers to develop business models while learning about recommended technologies (Laven, 2010). In spite of the change in the management structure and focus, cocoa extension methodology in Ghana is still based on the much linear technology transfer approach. Farmers are still considered as mere end users of technology instead of co-creators. A number of studies have showed that cocoa

farmers in Ghana accumulate more knowledge and adopt yield-enhancing technologies faster if they learn through more participatory methods (Dormon, 2006). One issue that is inadequately addressed in the literature is whether participatory methods also encourage similar or higher rates of adoption of quality-enhancing technologies than the current technology transfer extension approach. This issue is particularly interesting given the current organization of the cocoa market, in which farmers receive the same price for all quality of cocoa.

Mechanism design theory

The challenge for policy makers and cocoa buyers is deciding on what governance structures can address the asymmetric information problem and thus motivate farmers to increase the effort they apply to enhance the production of quality cocoa beans. Mechanism design theory provides insights on how to overcome this challenge (Hurwicz, 1973; Maskin, 2008; Myerson, 2008). The idea of mechanism design theory is that since policy makers or cocoa buyers are not able to match different bean quality characteristics to specific farmers, they can nudge them to reveal their private information by offering them a "menu" of trading options. The purpose of the menu is to attract farmers with different bean qualities to sell their produce under different trade arrangements. For instance, Ghana accepts two quality grades of cocoa beans, Grade I and Grade II. The theory suggests that policy makers and buyers can design alternative market arrangements for these grades. The challenge is to ensure that each farmer benefits by selecting the appropriate market outlet for his or her produce (Hurwicz, 1973; Maskin, 2008; Myerson, 2008).

Economists have proposed two categories of governance structures that can shape the interaction between farmers and buyers to address the asymmetric information problem. One is that buyers may try to sort farmers or their produce into different quality grades by using a screening device before purchase (Stiglitz, 1975). Related to agricultural markets, a much discussed screening device is certification or labelling (Stiglitz, 1975; Jahn et al., 2005). The second category of governance structures comprises self-selection devices. A self-selection device is a pricing scheme that combines rewards and punishments in a way that causes the farmer to reveal truthful information about the quality of his or her produce to the buyer (Guasch and Weiss, 1981; Salop and Salop, 1976).

Mechanisms of screening: Certification programs

Evidence from several commodity markets across world the suggests that certification is an effective governance structure to resolve problems of asymmetric information (Barham and Weber, 2012; Beuchelt and Zeller, 2011; Bolwig et al., 2009; Buehler and Schuett, 2012; Dorr and Grote, 2009; Jena et al., 2012; Kleemann and Abdulai,

2012). In many Ghanaian communities, farmers can choose between certification and the uncertified mainstream market. These two markets are governed differently. Some studies have mentioned that Ghanaian farmers organized under certification have higher productivity (Gockowski et al., 2013; Kleeman and Abdulai, 2012). Whether certification addresses the asymetric information problem and also attracts farmers to supply better quality cocoa beans is a subject of debate. It is also unknown how certification programs differ from the mainstream market in terms of motivating farmers to supply quality produce. Some studies suggest that paying price premia is the most effective incentive mechanism of certification programs (Lohr and Park, 1992; Valkila, 2009). Other studies point to non-price incentive mechanisms, such as farmer training, supervision of production, and social control through farmer organizations (Dorr and Grote, 2009). The literature on certification however focuses on yields and production methods and largely ignores the quality dimension of the produce. Specifically, the literature fails to address the issue of which incentive mechanisms certification schemes employ to elicit the high level of effort they require of smallholder farmers to produce crops of sufficient quality.

Mechanisms of self-selection: Test-cum-fee pricing

Hueth et al. (1999) propose that measuring quality before purchasing agricultural produce and paying a price based on quality grades may motivate farmers to supply good quality cocoa. However, simply testing the quality of cocoa beans and paying according to grades may not be sustainable. This is because the cost of the quality tests may be too high for the buyer given that farmers will supply both high and low quality grades. Self-selection devices or pricing strategies that induce farmers to reveal truthful information about themselves (Padilla, 2003). An example of a self-selection device is *test-cum-fee* pricing. A test-cum-fee pricing rule works in a similar way to the "carrot and stick" format (Mirrlees, 1997). The buyer offers a higher price for better quality grades on condition that farmers pay a fee to have their cocoa beans tested. When their cocoa beans are graded as high quality, farmers are paid a price that is over and above the test fee; otherwise the fee becomes their cost. In this thesis, the response of farmers to a menu of prices with two options, regular producer price and test-cum-fee pricing, is analysed in terms of supply of quality cocoa beans.

Test-cum-fee policies have been found to induce self-selection in the labour market sector. Employers willing to attract highly qualified workers sometimes require prospective employees to undergo a costly recruitment process. Guasch and Weiss (1981) demonstrate that this mechanism discourages disqualified workers from applying for jobs (Titman and Trueman, 1986). Similar positive results have been found in the educational sector with prospective students who have to bear the cost of

writing an entrance exam and/or pay application fees. An important hypothesis of this study is that when faced with a price differentiation with a test-cum-fee mechanism farmers will have the incentive to supply the best quality cocoa beans, as such reducing the cost of upgrading after purchase. There is, however, no empirical evidence in the literature to support this hypothesis.

1.4 Research objectives

Following the above-mentioned gaps in the theoretical and empirical literature discussed in Section 1.3, the overall objective of this study is to gain an insight into which institutional mechanisms can provide effective incentives for Ghanaian cocoa farmers to enhance the production of quality cocoa beans. Specifically, the following research questions are addressed:

1. to what extent did price-related institutional reforms in Ghana's cocoa sector favour farmers?
2. which institutional factors constrain smallholders from enhancing the production of quality cocoa beans?
3. how do farmers who learn about quality-enhancing technologies through participatory methods differ, in terms of knowledge and patterns of adoption, from those who learn through conventional extension?
4. what are the effects of the incentive mechanisms designed by certification programs on farmers' effort to enhance the quality of cocoa beans they produce? and
5. to what extent will farmers respond to price differentiation with self-selection in terms of supply of quality cocoa beans?

1.5 Overall approach to the research

1.5.1 Convergence of science research program

The research work presented in this thesis forms part of a Dutch-government funded inter-disciplinary research programme (2008-2014) called "Convergence of Sciences: Strengthening Innovation Systems" (CoS-SIS). CoS-SIS is a follow-up of an earlier research programme (2001-2006) "Convergence of Sciences" (CoS), which focused on the use of participatory technology development (PTD) to improve smallholder livelihoods (van Huis et al., 2007). A major conclusion of the CoS research program was that PTD significantly improved farmers livelihoods in specific communities (Dormon, 2006). There are, however, institutional factors above the control of farmers that hinder opportunities for smallholders to capture the gains of PTD (Hounkonnou et al., 2012). CoS-SIS therefore focuses on experimenting with how institutional change might open windows of opportunity for farmers to capture the gains of PTD. Inspired

by concepts of CoS-SIS, this study proceeded in two-steps: problem identification and empirical investigation.

1.5.2 Methods of problem identification

During the problem identification stage, two studies were conducted.

The first, diagnostic study employed time series data ranging from 1960 to 2012 to investigate the impact of price-related institutional reforms on cocoa producer incentives in Ghana. Co-integration and error correction modelling were used in this analysis. This study revealed how reforms of the organization that set cocoa producer prices in Ghana and also changes of the adopted pricing rule over time improved producer incentives (research question 1; Chapter 2).

Having assessed the importance of institutions for producer incentives at the macroeconomic level, the second diagnostic study tried to identify institutional factors that act as a disincentive for smallholder farmers to enhance the production of quality cocoa beans at farm-level (research question 2; Chapter 3). A multi-stage random sampling technique was employed to draw out respondents from farmers, cocoa buyers and COCOBOD officials in four agro ecological zones in Ghana for interview. Data were obtained from the respondents using focus group discussions, key informant interviews, participant observation, and semi-structured questionnaires. The study identified three categories of factors which undermine produce incentives: asymmetric information, inadequate knowledge of recommended quality-enhancing farm technologies, and insufficient incomes. So far, cocoa policies in Ghana did little to address these problems, especially the asymmetric information problem.

1.5.3 Methods of empirical investigation

The findings of the diagnostic studies were discussed with stakeholders of the cocoa sector through workshops, seminars, and one-on-one interactions. Following discussions with stakeholders and a systematic review of relevant literature, an empirical study was designed to identify the best learning method for improving farmer knowledge and adoption, given the existing market conditions where all cocoa beans above a minimum quality standard receive the same price (research question 3; Chapter 4).

This study was conducted in the Suhum cocoa district, using a quasi-experiment approach. Two sets of farmers were trained in Good Agricultural Practices for enhancing cocoa bean quality. One group was trained by with the farmer participatory research (FPR) approach, while the other group was under the regime of conventional extension methods. The impacts of the two different learning approaches on farmer knowledge as well as on the likelihood of actual adoption were estimated through

descriptive statistics and difference-in-difference (DiD) regressions. A salient finding of the experiment was that farmer education is necessary but not sufficient to motivate producers to enhance the production of quality cocoa beans. In the absence of pay-for-quality pricing, farmers adopted technologies that improved their yield more than those that improved the quality of their produce.

Two subsequent empirical studies were therefore conducted to experiment with how alternative rules and organization of the internal cocoa market may address the asymmetric information problem that hampers pay for quality. First, the effect of price and non-price incentive mechanisms of certification programs on farmers' effort to enhance quality was investigated (research question 4; Chapter 5). This study was carried out in the Oyoko cocoa district of the Eastern Region of Ghana, where an organic cocoa certification program runs alongside the mainstream market. Data were collected from a sample of 161 certified and 161 independent farmers. The data also allowed us to investigate factors that influence farmers' decision to participate in certification. Descriptive statistics involving means and frequencies, as well as propensity score matching techniques, were used to analyse the data. Farmers' decision to join certification programmes depend on their preference for more income or less effort. Certification schemes pay a higher price to producers in addition to a number of non-price mechanisms, such as bean testing before purchase and traceability, to elicit higher efforts from farmers. As a result of these mechanisms, farmers in certification programmes demonstrated significantly more effort in enhancing the quality of their produce than independent farmers.

The final empirical study tested a governance structure that assumed individuality, in an atomistic way, and economic rationality on the part of farmers. Over a period of two cocoa seasons, 60 farmers were subjected to a menu of prices with two options. In the first option, farmers could sell any quality grade above the minimum standard at the regular producer price. In the second option, farmers were offered a higher price if their cocoa beans met a certain quality standard. However, they were to subject their beans to a fixed pass-fail quality test which required an entry fee. The behaviour of farmers under this test-cum-fee pricing mechanism was compared to a control group of farmers who were not treated with a menu of prices. Farmers exposed to a menu of prices improved the average quality of their produce. Furthermore, they selected and improved the quality of a significantly higher proportion of their produce and sold it through the test-cum-fee option. This self-selection behaviour under test-cum-fee implied that cocoa buyers spent less on upgrading cocoa beans before onward sales. Hence a price differentiation with test-cum-fee options presents a win-win opportunity for farmers and buyers to address concerns about produce quality at farmgate.

1.5.4 Outline of the thesis

The thesis is divided into seven chapters (Figure 1.4). **Chapter 2** chronicles reforms in the organization which determines producer prices and how they changed the price-determination rules since 1960. An assessment of the impact of these price-related institutional changes on produce incentives in Ghana is presented. **Chapter 3** identifies salient institutional factors that act as a disincentive for farmers to enhance the quality of their cocoa beans. In **Chapter 4**, the linkage between farmer knowledge and adoption is examined. **Chapter 5** is dedicated to analyses of certification as an alternative market governance structure to address the problem of asymmetric information in Ghana's cocoa sector. The chapter begins with an assessment of certification activities in Ghana's cocoa sector before going on to estimate the impact of the specific programme we evaluated. In **Chapter 6**, the impact of a self-selection mechanism (i.e., test-cum-fee) on farmers' production activities is investigated. This analysis is preceded by a test-cum-fee theoretical model. In this chapter, also a historical overview of different mechanisms used to motivate farmers to enhance the production of quality cocoa beans is presented. **Chapter 7** synthesizes the findings of the various studies and then distils conclusions and policy implications.

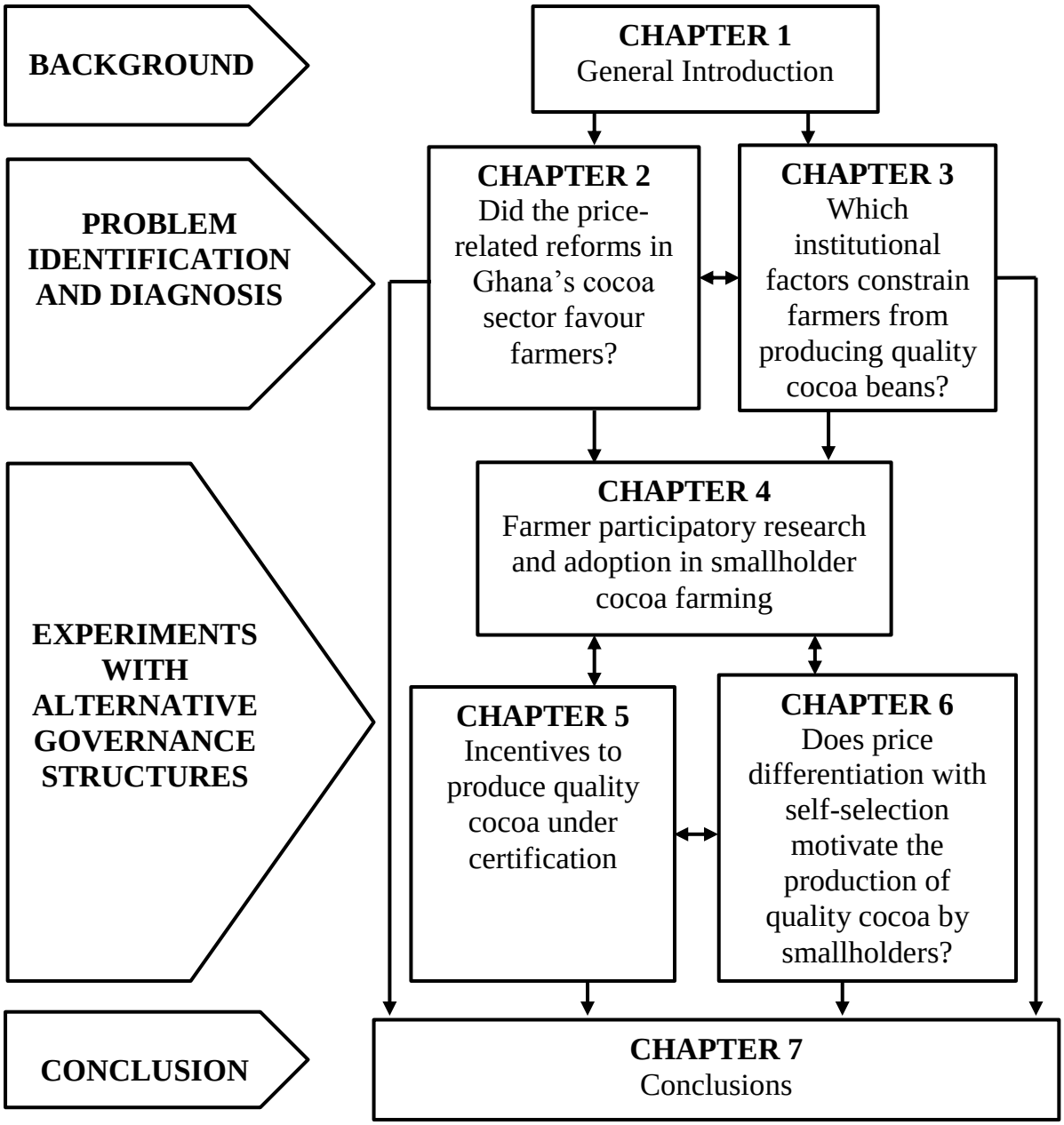

Figure 1.4 Thesis structure

Chapter 2

Did the price-related reforms in Ghana's cocoa sector favour farmers?

2.1 Introduction

To keep up with the growing global demand for sustainable cocoa, smallholder farmers in Ghana need to increase their investments in productivity and quality-enhancing farm activities (Laven and Boomsma, 2012; Afari-Sefa et al., 2010). Farmers are motivated to do so if they expect to be compensated in the future by sufficiently high and stable cocoa prices (Hattink et al., 1998; Ashitey, 2012). A higher share of the export price and more protection against fluctuations of world prices would support investments in sustainable cocoa and also improve the livelihoods of smallholders (Greene and Baron, 2001; De Janvry and Sadoulet, 2010).

Since World War II, Ghana's internal cocoa market has been characterized by institutional price setting rather than market pricing. The Cocoa Board, or COCOBOD, the cocoa governing organization in Ghana, has taken several steps to improve the price incentives for smallholder farmers (Acquaah, 1999, Gilbert, 2009). In particular, it has implemented a number of producer price-related institutional reforms. These reforms covered two aspects: changes in the organization that set producer prices and changes in the price setting mechanism or rule itself, that is, in how producer prices were calculated (Amoah, 1998; Lundstedt and Pärssinen, 2009; Laven 2010; Kolavalli, Vigneri et al., 2012; Laven and Boomsma, 2012). The objective of this chapter is to assess whether these reforms have managed to improve the price incentives for farmers. Specifically, we study how fast and to what extent world prices have been transmitted to Ghanaian farmers, and also compare the stability of the prices they received under the different reforms.

The literature shows mixed and incomplete evidence on the impact of Ghana's price-related reforms of the cocoa sector. Some studies suggest that producer prices were improved over time by the reforms (Laven, 2007; Ton et al., 2008; Vigneri, 2007). Other studies also find a general increase in cocoa prices and report a positive supply response from Ghanaian farmers (Gyimah-Brempong, 1987; Abdulai and Reider, 1995). However, based on data from 1970 to 1995, Baffes and Gardner (2003) find that farmers did not receive a significant price increase under the general cocoa

This chapter is submitted to the *International Journal of Agricultural Sustainability* as Quarmine, W., Haagsma, R., Huis, A.V., Sakyi-Dawson, O., Asante, F. & Obeng-Ofori, D. Did the price-related reforms in Ghana's cocoa sector favour farmers?

sector reforms in Ghana. Apart from this inconclusive evidence, there are no studies that pay systematic attention to the impact of the various reforms on the level and stability of producer prices. This chapter tries to fill this gap by assessing how much the specific price-related institutional reforms in the cocoa sector have increased prices and price stability and, hence, have contributed to the increase in cocoa production during the period 1960-2011. To lay the foundation for this exercise, we first try to identify to what extent total cocoa bean supply in Ghana actually responds to the producer price farmers expect and to the uncertainty about this expectation as captured by the variance of producer prices. This analysis is followed by determining the proportion of world prices that was transmitted to cocoa farmers over the years. Finally, we compare the price setting regimes with respect to whether they managed to stabilize producer prices over time.

Apart from addressing a gap in the literature, this chapter contributes to a growing recent discussion about how to structure incentives for sustainable cocoa production in Ghana (Laven and Boomsma, 2012). At the moment of writing, the Convergence of Science-Strengthening Innovations Systems (COS-SIS) Research Programme is involved in experimentation with innovation platforms. These experimental platforms bring together various stakeholders to create institutional reforms. In the particular case of Ghanaian cocoa, the COS-SIS platform is interested in lobbying for more reforms in the price formulation process (Hounkonnou et al., 2012; Röling et al., 2012). This chapter also seeks to provide input for the activities of this COS-SIS platform.

In the next session, a brief discussion of the relevant institutional reforms in Ghana's cocoa sector is presented. This is followed by a description of the methods employed in this chapter. The findings are then presented, and we round of with a discussion of the results and conclusions.

2.2 Price-Related Institutional Reforms

Following the economic crises between mid-1970s and early 1980s, the government of Ghana instituted a series of liberalization reforms beginning from 1984. As part of the reforms, the cocoa sector was reorganized. A number of these reforms were price-related and involved changes in "who sets prices" and "how prices are set".

2.2.1 Reforms of the price-setting organization

Prior to 1945, producer prices were determined through negotiations between farmer cooperatives and multi-national cocoa buying companies (Young et al., 1981). This changed when World Wars I and II brought in their wake a number of plummeting prices on the international market. Because these price falls were passed on to

producer prices, farmers suffered income losses and started upheavals. The British colonial governments in West Africa addressed this problem by establishing marketing boards. The central objective of marketing boards was to stabilize producers' incomes. In theory, when world prices are unstable, a marketing board is able to save (dis-save) during periods of high (low) world prices and in this way can stabilize prices for farmers (Cardenas, 1994).

Table 2.1 Summary of price-related institutional changes in Ghana's cocoa sector, 1960-2011

Period	Objective of price policy	Who sets the price	How are prices determined (rules)
1960-1983	Maximize government tax revenue	Mainly COCOBOD	*CPRICE Mechanism:* Based on World price, Farmers expectations, government revenue target etc.
1984-1998	Achieve positive real producer prices	Multi-stakeholder Producer Price Review Committee (PPRC)	*COP Mechanism:* Estimation of average cost of production (COP) and setting price to ensure 20% profit margin
1998-2000	Maintain positive real producer prices	Multi-stakeholder Producer Price Review Committee (PPRC)	*Negotiation:* Farmers negotiate prices with PPRC based on previous amounts received
2001-2012	Maintain net FOB price of more than 70%	Multi-stakeholder Producer Price Review Committee (PPRC)	*FOB Mechanism:* Industry costs are deducted from net COCOBOD revenue. A proportion of the remainder, net FOB, is paid to farmers

Since 1947, Ghana's cocoa sector has been managed by COCOBOD (Laan, 1987; Alence, 1990; Alence, 2001; Ruf, 2009). One of the central functions of COCOBOD was to determine the producer price for farmers. Until 1984, cocoa pricing decisions were carried out solely by COCOBOD, though subject to the approval of the government (Amoah, 1998). In 1984, as part of national reforms initiated after the economic crises, the government decided on using a multi-stakeholder process and employing a more scientific approach to producer price determination. The objective was that producer prices should have a closer relation to the costs in the supply chain, and also be at a level that farmers would motivate to produce higher volumes of quality cocoa beans. This would further improve their livelihoods. The government thus set up a multi-stakeholder platform called Producer Price Review Committee (PPRC), which comprised farmer representatives, government officials, university scientists, members of the Ministry of Finance and

Central Bank, licensed cocoa buyers, hauliers, and COCOBOD. Together they had to determine producer prices and the margins of other industry stakeholders like hauliers, input suppliers, and licensed buyers. Today, the PPRC is still the legally mandated organization that determines minimum producer prices.

2.2.2 Reforms of the price-setting process

Since the institution of COCOBOD, there have been three mechanisms of determining producer prices. The first mechanism, which lasted until 1984, had producer prices mainly set by COCOBOD's technical staff subject to government approval. Hereafter, this approach is referred to as CPRICE. The main objective of this mechanism was to set producer prices such that they maximized government tax revenue. Amoah (1998) mentions that COCOBOD developed an efficient system of forward sales that could guarantee maximum export revenues even if world prices showed high volatility. Based on current and expected export revenues, the technical staff of COCOBOD could estimate the optimal producer prices that maximized expected tax revenue. The key variables in the price setting process were tax revenue targets, world price trend, and farmer expectations. A major drawback of this mechanism was that it ignored to compensate farmers for changes in macroeconomic conditions such as trends in inflation. The real producer price therefore declined and fell below the level required to generate a higher supply response (Franco, 1979; Ofosu-Asare, 2011).

Eventually the CPRICE mechanism turned out to be a failure, largely because it discouraged farmers from cocoa production (Koning, 1986). However, during the CPRICE period, COCOBOD had developed a good database on cocoa production, which could be eventually used to improve the price setting mechanism (Amoah, 1998). One purpose of the establishment of PPRC in 1984 was to get all the stakeholders together in order to apply a more realistic approach to price setting based on appropriate data. A technical sub-committee was created within the PPRC to base producer prices on estimations of average production costs. Hereafter referred to as COP, this mechanism consisted of setting a producer price that compensated for this calculated average cost and moreover paid a 20% profit margin. In 1998, some stakeholders, especially farmers and licensed buyers, began to kick against the COP approach because of its unrealistic assumptions about the cost of production (Kolavalli et al (2012).

The PPRC responded by slowly abandoning the COP mechanism. In the years 1998 and 1999, the PPRC asked farmers and other stakeholders to negotiate for prices and margins on the basis of what they had received in the previous year. Hence the negotiations were still based on the COP approach. From the year 2000 onward, the new government in Ghana sought to increase the share of the world price farmers

received. The PPRC therefore introduced a new price determination mechanism that implied the payment of a percentage of the net freight on board (net FOB) price COCOBOD received when exporting cocoa. The calculation of the percentage involved projecting the gross revenue of COCOBOD and then deducting a number of industry-related costs (such as mass spraying of farms for pest and disease control, jute sacks, fertilizer fund, scholarship funds, child labour mitigation, anti-smuggling, etc.). The calculated percentage of the FOB price paid to the farmer was considered to be enough to cover the remaining costs and leave him some profit. The target of the PPRC has been to pay up to 70% of the net FOB price as producer price. An important difference between the COP and FOB mechanisms is that while the former focused directly on the actual costs of farmers, the latter considers all industrial costs and by doing so only indirectly deals with the costs of farmers.

2.3 Methods

2.3.1 Effect of producer prices on output

Basic economic theory suggests that cocoa production by farmers should depend positively on the producer price they expect and, granting that farmers are risk averse, negatively on the variance of the producer price. As a first exercise, we verified this implication by estimating a double-logarithmic model where cocoa production in year t (Q_t) is regressed on current and lagged producer prices (P_t^p), a producer price variance (VP_t^p), and a number of control variables, including the price of maize (P_t^m), time trend (T) and land area put to cocoa production (L_t):

$$Q_t = \alpha_0 + \alpha_1 P_t^p + \alpha_2 P_{t-1}^p + \alpha_3 P_{t-2}^p + \alpha_4 VP_t^p + \alpha_5 P_t^m + \alpha_6 L_t + T + \varepsilon_t \qquad (1)$$

Here it is assumed that farmers base their price expectation on a certain combination of current and previous prices, (i.e, P_t^p, P_{t-1}^p, P_{t-2}^p). The variance series of the producer price were calculated by relating the current and two previous prices to their (unweighted) average. Variance variables using more than two time lags in prices did not lead to significant outcomes. Current prices were added to the variation formula because prices are announced about four months into the season, hence, much of the farm investment is done on anticipation of the current price. Since maize is a major staple that competes with cocoa for farmers' labour, the price of maize (P_t^m) is expected to have a negative relation with cocoa output. Land area under production is expected to have a positive relation with output. All prices are in constant US dollars per metric ton. Equation (1) is estimated using ordinary least squares (OLS) methods. The main null hypotheses tested here are $\alpha_1 = \alpha_2 = \alpha_3 = 0$ and $\alpha_4 = 0$.

2.3.2 Transmission of world price to producer prices

Having identified how to verify the importance of producer prices for cocoa production, we investigate the impact of price-related institutional reforms in Ghana on the transmission of world price to producer price. For this, the co-integration and error correction approach employed by Baffes and Gardner (2003) was employed. It involves three steps. The first step was to investigate whether a long-run relationship exists between world price and producer price by specifying the following equation:

$$P_t^p = \beta_0 + \beta_1 P_t^w . D_t + \beta_2 P_t^w . (1 - D_t) + \mu_t \quad (2)$$

(also in double-log form). Parameters β_1 and β_2 represent the percentage change in producer price (P_t^p) resulting from a one percent change in world price (P_t^w), before and after the introduction of a specific institutional reform, respectively. D_t is a dummy variable with value 0 if *t* is a reform year and 1 otherwise. As before, prices are expressed in US dollars per metric tonne to eliminate the effects of exchange rate (Mundlak and Larson, 1992). The hypothesis of a long-run relationship is tested using the Engel and Granger approach. Equation (2) is first estimated with OLS methods. The error term series (μ_t) were generated and subjected to unit root (stationarity) tests based on the Augmented Dickey Fuller (ADF) procedure. A stationary error term implies that producer prices and world prices have a long-run relationship (Engle and Granger, 1987).

The second step is to employ an error correction model to establish the short-run relationship between producer and world prices. This involves the introduction of lags in equation (2) and imposing the homogeneity restriction: $\beta_1 + \beta_2 = 1$, on the slope parameters (see Hendry et al. (1984)). The implication of this restriction is that equation (2) can be transformed to:

$$(P_t^p - P_{t-1}^p) = \gamma_0 + \gamma_1 (P_{t-1}^w - P_{t-1}^p) . D_t + \gamma_2 (P_{t-1}^w - P_{t-1}^p) . (1 - D_t) +$$

$$\theta_1 (P_t^w - P_{t-1}^w) . D_t + \theta_2 (P_t^w - P_{t-1}^w) . (1 - D_t) + \mu_t \quad (3)$$

Parameter θ_i is an estimate of the proportion of a given change in the world price in the current year that is transmitted to the current producer price; i.e., the short-run effect. Parameter γ_i measures how much of the difference between world and producer price (referred to as mark up in this study) in the previous year is transmitted to the current producer price.

The third and final step in the price transmission methodology addresses the question: how long does it take for the producer price of cocoa to adjust to a given change in world prices within a given time period? Let A_t be the amount of adjustment

that takes place in t years, then the speed of adjustment can be calculated as (see Appendix):

$$A_t = 1 - (1 - \theta_i)(1 - \gamma_i)^t \quad (4)$$

(Note that, because of the dummy variables, the subscript i has either $i = 1$ or $i = 2$). The closer the estimated parameters, γ_i and θ_i, are to unity, the higher the rate of price transmission, A_t. Equations (2) and (3) were estimated with OLS methods. The estimations are carried out in logs so that the parameters can be interpreted in terms of percentage changes. Co-integration and error correction methodology requires that all variables in a regression have similar properties to avoid spurious regression results. Before estimations are conducted, we therefore run Augmented Dickey Fuller tests of unit roots on producer and world prices to be sure that they have similar stationarity properties. The impact of price-related institutional reforms is captured by introducing dummy variables into equations (2) and (3).

2.3.3 Stability of producer and world prices

The variability of prices is estimated around the best-fit time trend. This is done by estimating the following regression:

$$P_t^i = \alpha_0 + \alpha_1 Time + e_t \quad (5)$$

where P_t^{i} denotes either world or producer prices. Equation (5) is estimated for both world and producer prices. The variance of the model with respect to the time trend, $\sum e_t^2/(n-2)$, is used as a measure of the stability in prices over time. If there is no significant time trend, the variance is calculated relative to the mean of the prices.

2.3.4 Sources of data

Annual world and producer cocoa price data series from 1960 to 2011 are employed for the analyses. World cocoa prices were obtained from the International Cocoa Organization (ICO) data files and represent an average of the daily price per metric tonne of the first three positions on the terminal markets of New York and London. Producer prices, which represent the price per metric tonne paid to cocoa farmer by COCOBOD captured in US$, were obtained from COCOBOD annual reports. The exchange rate employed in this study is the official exchange rates published by the International Monetary Fund's International Financial Statistics publication (IMF-IFS). Yearly data on land area put to cocoa production is obtained from the database of the Food and Agriculture Organization (FAOSTAT). Price of maize is obtained from the Ministry of Food and Agriculture, Ghana.

2.4 Results

In this section we summarize the econometric results based on equations (2), (3), (4) and (5).

2.4.1 Producer prices and output

Table 2 details the results of a linear regression analysis of producer price and producer price variance on annual cocoa bean output for the period 1970-2011 (Equation 2). The R-squared statistics reveal that the variables of the regression explain about 88.0% of the variation in cocoa output. The regression only slightly suffers from autocorrelation (see Durbin Watson statistic). Producer price has a significant positive effect on cocoa production and price variation a significant negative effect. Other things being equal, a one percent increases in the price of cocoa results in a 0.15% increase in the production of cocoa beans. If the variation in prices increases by one percent, however, production will be expected to drop by about 0.01%. The price of maize shows a significant negative sign on cocoa production. When the price of maize increases by one percent, farmers are likely to reduce cocoa output by about 0.44%. Table 2.2 further confirms a significant positive effect of the amount of land put in cocoa.

Table 2.2 Results of regression of producer price on cocoa output, 1970-2011

	Coefficient	**t-statistics**	
Constant	12.250	11.391	***
Producer price	0.1527	2.191	***
Producer price lagged one year	0.0211	0.259	
Producer price lagged one years	-0.053	-0.854	
Producer price variation	-0.012	-1.855	**
Price of maize	-0.441	-8.305	***
Land area	0.126	1.859	**
Time trend	0.117	6.237	***
	Regression diagnostics		
R-squared			0.878
Adjusted R-squared			0.852
F-statistic			33.810 (0.000)
Durbin-Watson stat			1.498

*, **, *** indicates significance at the 10%, 5%, and 1% level, respectively

2.4.2 Transmission of world prices to producers

A central question of this chapter is: to what extent do producer prices follow world prices and does this differ by institutional regime? A first impression is given by plotting the time profiles of world and producer prices. Figure 2.1 shows natural logarithms of world and producer prices - US$/metric tonne from 1960 to 2011). Throughout this period, producer prices have often followed changes in world prices. Producer prices have moved closer to world prices particularly since the institution of the PPRC in 1984. The correspondence is closer between 2000 and 2011, when the PPRC adopted the net FOB approach to price setting, as compared to the periods when prices were determined by COP (1984-1999) and CPRICE (1960-1983).

The relative producer price, i.e., the ratio of producer price and world price, has changed for farmers under the various periods of reforms (Figure 2.2). Prior to the institution of PPRC in 1984, producer prices as a proportion of world prices dropped from 0.65 in 1960 to 0.05 in 1984. The introduction of price-related reforms in 1984 was a turning point for the position of farmers. The relative producer price rose gradually from 0.05 to about 0.71 in 2011. This suggests that the institution of price-related reforms has improved relative prices from the farmers' perspective. The kink in 1980-83 just before the reforms can be attributed to the depreciation of the cedi in these years. Whereas the CPRICE period (1960-1983) resulted in a free-fall of farmers relative producer price, both the COP and FOB periods altered this trend (Figure 2.2).

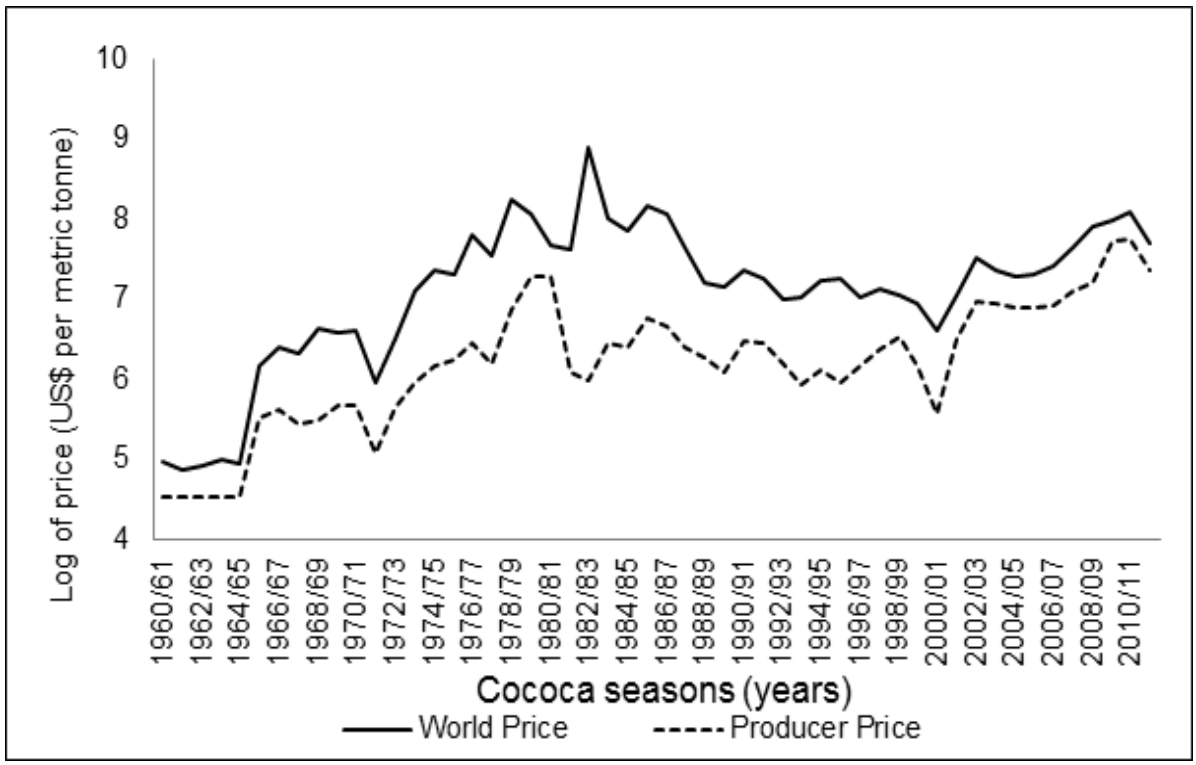

Figure 2.1 Time profile producer and world prices in US$ per metric tonnes, 1960-2011

Whereas the time profiles in Figures 2.1 and 2.2 suggest a co-movement between world and producer prices, co-integration procedures give a more rigorous estimation. First, we carried out ADF tests for both price series in logs (Table 2.3). Both price series were non-stationary (i.e., they contained unit roots) in their levels, but became stationary after first differencing. This means that they both have the same statistical properties. Having ascertained this, the long-run relationship between producer and world prices was tested with the ADF tool. Three separate regressions based on equation (2) are presented in Table 2.4. Model I summarizes the results for the pooled sample without imposition of reforms. Model II introduces the major institutional reform, viz. the establishment of PPRC. Model III distinguishes between the three price-setting mechanisms. From the results of an ADF test on the error term of each regression, the null hypothesis of no co-integration (no long-run relationship) between world price and producer price is rejected. Hence, before and during the era of all the reforms, producer prices have indeed followed world prices, just as suggested by Figure 2.1.

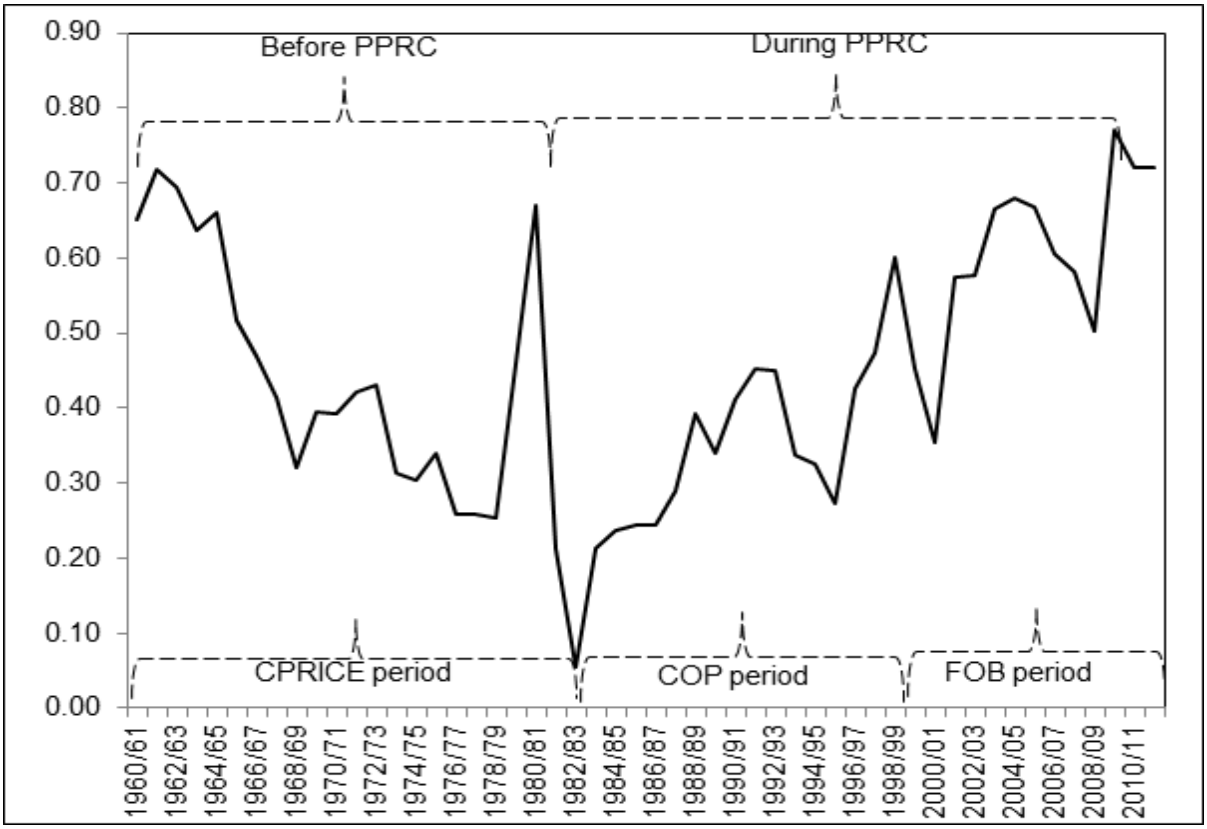

Figure 2.2 Time profile of log of relative prices (world price divided by producer price), 1960-2011

Table 2.3 Unit root tests for log of world and producer cocoa bean prices

	Data in levels		First differenced data		
Variable	ADF	MCV	ADF	MCV	Conclusion
Producer price	-1.847	-0.292	-5.897	-2.923	I(1)
World price	-3.084	-2.923	-7.690	-2.922	I(1)

ADF represents estimated Augmented Dickey Fuller statistic. MCV denotes critical values based on MacKinnon (1996) one-tailed p-values. I (1) indicate that the variable being examined becomes stationery after first differencing.

Given the long-run relationship between the two prices, the extent of transmission from world price to producer price is closely examined on the basis of equation (3), using the three different models (Table 2.5). In Model I, where we leave out any institutional reform, 33% of the variation in producer prices is explained by changes in world prices in the short run. We see that there is significant transmission of world prices to producers. A one percent increase in the world price leads to a short-run improvement of the producer price by 0.54%. The adjustment coefficient reveals that 0.25% of the change in the previous year's mark-up (difference between world and producer prices) was transmitted to producer prices annually. In addition, within one year, producer prices moved closer to world prices at a rate of 65.5%.

Table 2.4 Long-run relationship between world and producer price

	Period of regression	Regression Coefficient (t-value)	Residual (error tem) diagnostics			
Model			R^2	ADF	MCV	
I	All data (1960-2011)	0.75668 (11.779)***	0.730	-3.445	-2.920	I(0)
II	Before PPRC (1960-1983)	0.00029 (4.394)***				
	During PPRC (1984-2011)	0.00012 (7.987)***	0.55	-3.676	-2.920	I(0)
III	CPRICE (1960-1983)	0.00011 (4.023)***				
	COP (1984-1999)	0.00002 (5.378)***	0.58	4.582	-2.920	I(0)
	FOB (2000-20012)	0.00004 (8.461)***				

Dependent variable is the log of producer price. *, **, *** indicates significance at the 10%, 5%, and 1% level, respectively. Results represent ADF test of unit roots on the error term generated from Equation (2) with data under different institutional reform periods. MCV denotes critical values based on MacKinnon (1996) one-tailed p-values. I (0) indicate that the residual variable do not need differencing to become stationery hence the null hypotheses of no long run effect is rejected

In Model II, the short-run price transmission is compared before and during the era when PPRC set producer prices. Table 2.5 shows that in both periods, short-run price transmission was significant. It can be observed however that the difference in

short-run transmission between the two periods was only marginal. A one percent increase in world prices resulted in a significant improvement in producer prices by 0.55% and 0.54% before and after the institution of PPRC, respectively. Adjustment-coefficient results from Model II show that while 0.25% of the change in the mark-up in previous year was passed to farmers annually before PPRC, this increased to 0.28% after the establishment of PPRC. Comparing the speed of adjustment estimations in Model I, we observe only a slightly faster rate of price transmission in the period under PPRC (67.3%) compared to the period before (66.0%).

Table 2.5 Results of Error Correction Model for world and producer cocoa prices under different institutional regimes

		Coefficients				Regression diagnostics		
		Constant variable	Adjustment variable ($P_{t-1}^{w} - P_{t-1}^{p}$)	Short-run variable ($P_{t}^{w} - P_{t-1}^{w}$)	1 year speed of adjust-ment (A_t)	Adj R^2	DW	F Stat
Model I	All data	-0.198 (2.075)*	0.250 (2.667)*	0.540 (4.831)*	0.655	0.330	1.72	13.3*
Model II	Before PPRC	-0.212 (-.064)*	0.249 (2.523)*	0.547 (4.747)*	0.660	0.303	1.71	6.4*
	During PPRC		0.284 (2.256)*	0.543 (4.454)*	0.673			
Model III	CPRICE	-0.165 (-.060)*	0.367 (2.667)*	0.071 (1.742)*	0.412	0.230	1.77	3.5*
	COP		-0.020 (-1.412)	0.091 (2.069)*	0.073			
	FOB		0.561 (2.098)*	0.247 (3.811)*	0.670			

For each model the dependent variable was the first difference of the producer price in natural logarithms ($P_{t}^{p} - P_{t-1}^{p}$). t-values are in parenthesis*, indicates significance at the 5% level. DW denotes Durbin Watson statistic.

Model III summarizes the short-run price transmission under the different price-setting regimes considered in this chapter. The short-run transmission of world price to producers was positive significant under each of the compared price-setting regimes (Table 2.5). Short-run transmission was by far the highest under the FOB mechanism. Specifically, a one percent increase in world price leads to a significant change in producer prices by 0.07%, 0.09%, and 0.25% under the CPRICE, COP, and FOB price mechanisms. The adjustment coefficient in Model III reveals that under the CPRICE mechanism, about 0.37% of the change in the mark-up in previous year was passed to farmers annually. Under the COP mechanism, the adjustment coefficient was not significant, indicating that changes in mark-up were not transmitted to farmers. Under the FOB mechanism, however, about 0.56% of the change in mark-up was passed to

producer prices. Comparison of the one-year adjustment under each regime shows that producer prices adjusted faster to world prices under the FOB (67.0%) compared to the CPRICE (41.2%) and COP (7.3%) producer price regimes.

2.4.3 Producer price stability under the different reforms

Comparing the variances before and after the establishment of PPRC, variations in world prices during both periods were higher than variations in producer price (Table 2.6). Producer prices have been more unstable after the establishment of the PPRC than before. Before 1984, producer price variation as a percentage of world price variation was 7.1% while during the reform it increased to 24.6%. Thus, with the establishment of PPRC more of the world price variation has been passed on to the farmer. With regard to reforms in the price-setting mechanism, later regimes experienced more stable world prices. Under CPRICE, world price variation reduced from 1,065,329 to 258,067 in the period of COP, and further to 159,932 in the FOB era. However, producer price variation did not follow this pattern. While the proportion of producer and world price variation was only slightly different between the CPRICE (7.1%) and COP (6.0%) period, under FOB it was considerably higher (65.6%).

Table 2. 6 Variances of world and producer prices

Periods of institutional reform	Variation around trend		
	World prices (A)	Producer prices (B)	Proportion (B/A)
Before PPRC (1960-1983)	1065329.27	75390.90	0.071
During PPRC (1984-2011)	582227.69	143052.92	0.246
CPRICE (1960-1983)	1065329.27	75390.90	0.071
COP (1984-1999)	258066.57	15348.51	0.059
FOB (2000-20012)	159932.30	104994.30	0.656

2.5 Discussion and conclusions

The main purpose of this study was to investigate the extent to which institutional reforms in Ghana's cocoa sector influenced the price incentive for farmers during the period 1960-2011. The study began with assessing the impact of producer price expectations and the related uncertainty about future producer prices on total cocoa bean supply. The chapter then probed the transmission of world prices to producer prices and the extent to which the latter were stabilized under different institutional reforms in Ghana. Two aspects of the institutional reforms were emphasised: changes in the price-setting organization and changes in the price-setting mechanism.

Consistent with economic theory, cocoa producers in Ghana respond positively to producer prices and negatively to price instability. Earlier studies, which used somewhat different methods to estimate price elasticities of supply, also found positive relations between prices and cocoa output over the years (Gyimah-Brempong, 1987; Abdulai and Reider, 1995). We have contributed to the discourse on supply response by capturing and demonstrating the importance of producer price uncertainty to production.

With the introduction of various reforms, the fall in producer price as a proportion of world price was not only halted but turned into an upward trend in 1983/4. Relative prices have subsequently increased above the 1960 position. The reforms led not only to higher producer prices, but also a faster rate of transmission of world prices to producers. These findings are in line with the results from other countries where agrarian reforms have been implemented (Krivonos 2004; Mundlak and Larson 1992). In this chapter we have contributed to the literature by applying the techniques of Baffes and Gardner to a longer time series and found significant impact of the reforms on producer prices contrary to their earlier findings of no impact. Furthermore, this study has made a distinction between the effects of different pricing rules on producer prices (Mundlak and Larson, 1992; Baffes and Gardner, 2003; Krivonos, 2004).

The rather positive impact of the establishment of the PPRC on producer prices as compared to the period before the reform can be explained, first, by the greater transparency of the price setting process. Compared to the period before the reform (also termed CPRICE), farmers were more involved in the process and so could negotiate for better prices. Second, the price setting process could be based on more realistic assumptions because of the availability of a richer data set collected at an earlier stage (Amoah, 1998). Third, the PPRC was introduced at a time when the government had decided to improve and stabilize the producer price in terms of US dollars, so that, given the then upward trend in world prices (in US$), it was easy for the PPRC to recommend higher producer prices (in cedis, which had a constant decreasing value against the US$). A final reason is that the introduction of the PPRC coincided with reorganizations of the management and operation of COCOBOD. Some of the subsidiaries of COCOBOD had been shut down, the staff size had been cut, and input sale as well as bean trading responsibilities of COCOBOD had been reduced (Essegbe and Ofori-Gyamfi, 2012). This meant that COCOBOD transactions costs had declined over time and so more of the world price could be passed on to farmers.

Comparing the impacts of the three different price-setting mechanisms, we think that the lack of a statistically significant price transmission under the COP

regime must be explained by the rigidity in the price setting process. By adopting a price rule where producer prices were based on production costs, producer prices became disconnected from developments in world prices. The pricing rule seems in contradiction with the objective of PPRC to pay higher prices to farmers. The latter were frustrated that higher world prices could not improve their livelihoods anymore, which explains the agitation of farmers against the COP regime.

Our evaluation of the net FOB pricing mechanism suggests a win-win situation for both COCOBOD and farmers. Under the FOB regime, the transmission of world prices to producer prices was largest. A probable explanation lies in the flexible method of price setting and in political factors. Farmers received both compensation for some costs of production (albeit indirectly) and a proportion of the world price, without compromising COCOBOD's revenue expectations. Moreover, the PPRC was often pressured politically to transmit larger shares of the net FOB price to producer prices (Kolavalli et al., 2012). At present, some studies suggest that farmers do not have enough political clout to countervail COCOBOD current prices (Anang et al., 2011; Lundstedt and Pärssinen, 2009). However, historically, cocoa farmers have always been a delicate group for politicians to manage due to the welfare consequences of cocoa prices for millions of rural households (Milburn, 1970; Ton et al., 2008). In the colonial era farmers had boycotted the sale of cocoa beans. In the more recent times they ignored the cocoa farms. Eventually successive governments, recognizing the influence of cocoa farmers, often urged the PPRC to pass more of the net FOB price to farmers.

This impressive price transmission has, however, occurred at the expense of price stability. As has been demonstrated in this chapter, throughout the study period, producer prices were more stable than world prices. Nevertheless, the establishment of the PPRC did not lead to better price stabilization. We have indicated that producer price variation has been largest under the FOB, as compared with the COP and CPRICE regimes. While higher producer prices present an opportunity for small farmers to increase investments, unstable prices thwart planning, make investments more risky and, hence, discourage expanding production. This ultimately means that farmers lose the opportunity to improve their incomes (Duncan, 1991; Rezitis and Stavropoulos, 2012; Robison and Barry, 1987).

These findings question the effectiveness of COCOBOD's price stabilization policy, which is to sell cocoa beans in forward markets in order to protect producers from world price fluctuations (Gilbert, 2009). The stability of producer prices under FOB has been the weakest, again because of the focus of the pricing rule on changes in world prices. The transmission of a larger proportion of the world price comes along with more uncertainty. Note, however, that the estimated elasticity of producer price is

higher than the relatively small elasticity of price variation (Table 2). It suggests that the shortcomings of the price stabilization policy under the FOB regime did not have so much consequence for cocoa production as it might have had for the stability of farmer incomes and livelihoods.

We have shown that expected prices and the uncertainty about them are important determinants of farmer output. Institutions, *viz.* price-setting organizations and their policy rules are important for meeting farmer expectations of stable prices. Also, in an agricultural sector where prices are not competitively set on the open market, a transparent multi-stakeholder price-determining organization is better suited at setting prices that provide incentives for investment in sustainable production. The more flexible FOB approach adopted by the PPRC presents a better mechanism for cocoa price determination in Ghana compared to the rigid rule of the COP method. The positive impacts of the FOB approach are re-enforced by the multi-stakeholder price-setting environment. Farmers are able to negotiate for better prices depending on world price trends, having in mind that some of their production costs will be compensated for. This, added to the minimum stabilization farmers receive from forward sales of cocoa, has motivated higher production since the reforms. One issue which requires the attention of policy makers and further research is the trade-off between higher producer prices and stable prices which has been identified in this chapter. Price-related reforms were partly based on liberalization policies. With the liberalization of the market, farmers have received better prices as expected, but their need for protection against the price fluctuations on the world market has probably grown.

This far, we have observed that producer price changes depend on trends in world prices. With the introduction of the FOB pricing rule, producer prices have also depended on the level and stability of industry costs. If producers are to continue receiving a higher proportion of FOB price, industry costs needs to decline. Questions about the determinants of industry costs and their impact on the cocoa sector therefore require further investigation. This is one of the important issues which the Cocoa Domain of CoS-SIS has been addressing since 2009. For instance, the mass spraying component of industry cost has been investigated by the CoS-SIS cocoa CIG platform. The platform has proceeded to engage with several industry stakeholders for further institutional reforms in the management of mass spraying and other industry costs in the interest of smallholder farmers (Adu-Acheampong 2010). These activities of the CoS-CIG cocoa CIG are likely to lead to further reforms in the producer pricing rules and potentially to improvements in smallholder livelihoods.

Chapter 3

Incentives for cocoa bean production in Ghana – Does quality matter?

3.1 Introduction

Cocoa beans exported from Ghana attract a substantive quality premium compared to cocoa from other countries (Jano and Mainville, 2007; Wahyudi, 2008). These quality premia partly explain the high revenue Ghana earns from cocoa, totalling about 30% of Ghana's total export revenue and about four percent of GDP[1]. Ghana's status as a supplier of premium quality cocoa is a result of strict post-production quality control measures (Williams, 2009). The volume of high-quality beans can further be increased if farmers would be motivated to enhance the quality of harvested cocoa beans (Kotey et al., 2008; Kpodo, 2006; Laven, 2007; Osei, 2007).

The question is why cocoa farms in Ghana do not reach their full yield and quality potential. It is thought that institutional factors hinder farmers' incentives to enhance the quality of the cocoa beans they produce (Dormon and Sakyi-Dawson, 2009). The Convergence of Science – Strengthening Innovation Systems (CoS-SIS) research programme, of which this study forms part, proposes to tackle the quality concern in Ghana's cocoa sector through experimenting with institutional change (Geels, 2002, 2004; Hounkonnou et al., 2009; Kemp et al., 1998; Rip and Kemp, 1998). The CoS-SIS approach involves identification and facilitation of institutional changes that might provide incentives for Ghanaian cocoa farmers to enhance the quality of the cocoa beans they produce. Quality cocoa here refers to cocoa that is well fermented, dried, and free from disease, contamination and other physical defects.

Because the kinds of change that might achieve this quality objective are complex and cannot be known in advance, industry stakeholders acting together in a Concertation and Innovation Group (CIG) have been convened to identify, develop and implement institutional experiments to discover which options work best. In the cocoa domain, the success or otherwise of the CoS-SIS approach will depend on how thoroughly the issue of farmers' incentives to enhance cocoa bean quality is understood. This chapter is based on a diagnostic study of the institutional factors that

This chapter is published as Quarmine, W., Haagsma, R., Sakyi-Dawson, O., Asante, F., van Huis, A., & Obeng-Ofori, D. (2012). Incentives for cocoa bean production in Ghana: Does quality matter? *NJAS - Wageningen Journal of Life Sciences, 60-63*(60-63), 7-14

[1] Bank of Ghana Annual Report, 2009

have been identified as constraining farmers' practices to enhance the production of quality cocoa beans. Other studies that analyse the cocoa sector of Ghana from an institutional point of view do not pay much attention to the incentive structures which might motivate smallholder farmers to enhance the production of quality cocoa beans (Abenyega and Gockowski, 2003; Asenso-Okyere, 1990; Baah, 2008; Bateman et al., 1990; Takane, 2000).

The objective of this chapter is to identify the institutional factors that act as a disincentive to farmers to enhance the quality of their cocoa beans. Specifically, the chapter addresses four issues: (1) How do the key actors of Ghana's cocoa sector define quality? (2) What is the state of cocoa bean quality in Ghana? (3) What are the institutional and socio-technical reasons underlying the cocoa bean quality problem? and (4) What institutional or policy alternatives are likely to address the quality problem in the cocoa sector in Ghana?

The study was based on two assumptions: (1) the quality of cocoa beans produced and exported from Ghana depends on the actions and interactions of all the actors in the cocoa sector; and (2) institutions shape the incentives for these actions and interactions (Woodhill, 2008). Institutions are "...the set of common habits, routines, established practices, rules or laws that regulate the relations and interactions between individuals and groups" (Edquist and Johnson, 1997; Hall et al., 2006). Actors in this study refer mainly to those individuals or organizations involved with the physical handling of cocoa beans from production to export. They include farmers, Licensed Buying Companies (LBCs) which buy cocoa beans from farmers on behalf of the third-party actor, and the Cocoa Board (COCOBOD). The latter is a parastatal that governs the industry and also handles all cocoa bean exports.

3.2 Methodology

3.2.1 Study context

CoS-SIS selected the cocoa sector as one of its research domains because of this sector's importance to the national economy. Problem identification for the cocoa domain of CoS-SIS programme was carried out in three phases. Firstly, a scoping study was conducted which identified the main concerns in the cocoa sector of Ghana (Dormon and Sakyi-Dawson, 2009). Secondly, stakeholder workshops were held throughout the cocoa belt to identify and prioritise the possibly inadequate incentives for farmers to enhance quality. This chapter relates to the third phase, and reports the findings of a follow-up diagnostic study of the prioritised problem. The analysis is conducted mainly from the perspective of the cocoa farmer. Such a perspective is appropriate since it is the farmers' response to any institutional improvement that is likely to enhance the quantity and quality performance of the sector.

3.2.2 Sampling procedures

The study was carried out from June to September 2010, comprising 38 'cocoa districts' that coincide with the administrative districts of Ghana as indicated in Figure 1.1 (See Chapter 1). Data were collected at three levels of aggregation: village, district, and national level. Multi-stage cluster sampling was employed to select respondents at the village and 'cocoa district' levels. At the village level, data were collected from farmers and the purchasing clerks of the LBCs. At the district level, data were obtained from the staff of Quality Control Company, Cocoa Extension Coordinators of COCOBOD, and District Officers of the LBCs. Convenience sampling was used to select one key informant from each relevant organization at the national level, including COCOBOD, cocoa processors, and input companies.

In order to select respondents from village and district level, the 38 districts were clustered into four cocoa agro-ecological zones, based on the assumption that climatic factors may affect cocoa bean quality (Oluyole, 2010). One cocoa district was selected randomly from each zone: Assin Foso from the coastal savannah, Suhum from the deciduous rain forest, Wassa Akropong from the rain forest, and Dormaa Ahenkro from the transitional zone. Next, simple random sampling techniques were used to select three cocoa-growing villages from a list of villages in each of the four districts. Nkranfuom, Ayitey, and Wura Kesse were selected from the Assin Foso district; Anum Asuogya, Duodukrom, and Kuano from the Suhum District; Nkrankwanta, Esikesu, and Diabaa from the Dormaa Ahenkro District; and Bogoso, Donkor Krom, and Oppong Valley from the Wassa Akropong District (Table 3.1).

Table 3.1 Sampled districts and villages

Ecological zone	District	Villages
Coastal savannah	Assin Foso	Nkranfuom, Ayitey, Wurakese
Deciduous rain forest	Suhum	Asuogya, Duodukrom, Kuano
Rain forest	Wassa Akropong	Oppong Valley, Bogoso, Donkorkrom
Transitional zone	Dormaa Ahenkro	Essikeso, Diabaa, Nkrankwanta

Source: Field data 2010/2011

A two-stage sampling procedure was used to select farmers in each village. In the first round, five cocoa farmers were purposively selected in each village and invited to participate in focus group discussions. They were selected because of their general knowledge of the sampled communities, and helped us to draw up a tentative list of cocoa farmers in the village. In the second round of sampling, 10 cocoa farmers were randomly selected from each village using this tentative list as sampling frame, making a total sample of 120 farmers. In addition, in each village, further information

was obtained from two purchasing clerks of LBCs and two members of the government's mass cocoa spraying gangs.

3.2.3 Data collection and analytical procedures

A semi-structured questionnaire was used to collect data from the 120 farmers. A checklist was used to guide the focus group discussions and key informant interviews with the institutional actors. Further information was obtained from desk review of official documents from COCOBOD. Descriptive statistics involving frequencies and percentages and content-analyses were used to analyse quantitative and qualitative data, respectively. Quantitative data was analysed using SPSS. The socio-technical root system tool was used to analyse the technical and institutional causes of poor cocoa bean quality. This tool helped us first to identify the central problem and then to provide biological or technical explanations for the problem, before going on to unravel the institutional cause of the technical reasons identified (Leeuwis, 2004).

Findings from the diagnostic study were further validated during meetings of the Cocoa Concertation and Innovation Group (CIG). Key findings were presented at a meeting of the CIG where participants made their input into the study. This meeting was attended by representatives from Quality Control Company, Ghana Standards Board, Cocoa Inputs Company, Kuapa Kokoo (LBC), Cocoa Research Institute of Ghana (CRIG), University of Ghana, and the Ministry of Finance.

3.3 Findings and Analyses

3.3.1 Definition and perceptions of cocoa bean quality

The international cocoa market defines quality in four main ways, as applied and certified in exporter-buyer contracts: (1) physical quality; (2) bio-chemical quality; (3) process quality; and (4) origin quality (Asuming-Brempong et al., 2008; Poulsen et al., 1996).

Physical quality relates to the moisture content, disease infestation, defectiveness of beans, mouldiness, and the presence of foreign matter (Dand, 1999; Sukha, 2003). Both the domestic and the international market enforce physical quality standards because it is easier to assess prior to export. COCOBOD sets and enforces minimum physical quality standards that are higher than the international market standards. These higher standards are imposed because of the likelihood of cocoa beans to deteriorate in transit from farms to the final market destination. By Ghanaian standards, a bag of cocoa beans is graded Grade I cocoa if it is well fermented, has up to 7.5% moisture content and not more than 3% of cocoa beans with any of the other defects. Grade II cocoa is comparable with premium quality standards worldwide. It tolerates 4-8% of cocoa beans with any of the other defects, in addition to good

fermentation and up to 8.5% moisture content. Moreover, all cocoa bags must contain cocoa beans of uniform size. While all other actors in Ghana's cocoa sector have accepted the physical quality standards of the COCOBOD, the farmers interviewed were generally unaware of these specific standards.

Bio-Chemical quality focuses on butter content, flavour chemicals, heavy metals, poisons, and the level of chemical residues left on the bean (Gilmour, 2009). Ghana is known for the production of cocoa beans of a high chemical quality. Recently, however, concerns have been raised about the chemical residues on its beans. On two occasions, cocoa beans from Ghana have been rejected from Japanese and American markets, because they exceeded the minimum chemical residue requirements. With the exception of COCOBOD, the parameters of the chemical quality standards appear to be unknown to most cocoa actors. Nevertheless, key informant interviews revealed that COCOBOD acknowledges the importance of chemical quality and has taken steps to control chemical usage in the cocoa sector. COCOBOD is also in the process of setting up laboratories to test for the presence of chemical residues on cocoa beans prior to export.

Process quality refers to the production process of cocoa: whether organic or inorganic methods are employed; whether child labour is used; and whether the production process and subsequent rewards benefit the farmer and his community (fair trade) (Ponte and Gibbon, 2005). The farmers and the LBCs interviewed did not consider that process quality was an important component of cocoa bean quality. COCOBOD is, however, interested in maintaining Ghana's good quality image on the international market and has taken steps to include process-quality control into its policies. For instance, child labour on cocoa farms in Ghana has been minimized. Some cocoa districts have been marked as organic cocoa zones, while Kuapa Kokoo Ltd has been certified as a fair trade LBC.

In general, however, the results from the interviews with farmers revealed that the majority of the respondents (71%) acknowledged the importance of cocoa bean quality to the development of the sector (Table 3.2). Also, all of the LBC staff interviewed regarded cocoa bean quality as being important to the sector. This perspective of farmers and LBCs is in line with COCOBOD's vision to "Encourage and facilitate the production and processing of premium quality cocoa...."[2].

3.4 State of cocoa bean quality in Ghana

Given the current area under production, cocoa farms in Ghana have the potential of producing up to 1,000,000 MT of premium quality cocoa annually, yet actual

[2] *Source: The mission statement of COCOBOD*

production has not exceeded 750,000 MT (Breisinger et al., 2008). One explanation for this is that a great proportion of the cocoa output of farmers suffers from diseases and poor handling prior to purchase by LBCs, and are thus regarded as cocoa waste (Osei, 2007). National data on cocoa waste are available, but these data do not provide the total volume of cocoa going waste on farms because they capture official cocoa waste purchased by licensed cocoa waste buyers only in specific parts of the country. Yet, information gathered from various editions of COCOBOD's annual reports suggests that cocoa waste as a percentage of annual production has increased from about 1.5% in the 1999/00 season to about 7% in the 2008/09 season. Although these figures represent official records of cocoa waste purchased in just a few communities, there is no reason to expect that these figures will be very different in other communities. Therefore, these percentages give a clear indication that farmers can do more to increase the volume of quality cocoa beans they sell.

The study found during key informant interviews with COCOBOD officials and LBCs that even the cocoa beans bought by LBCs sometimes failed COCOBOD's strict quality control procedure at district depots. Sometimes bags of cocoa beans fail quality tests because the beans are not well dried, not of uniform size, or simply defective. If cocoa beans are not well dried, then LBCs are asked to dry the beans to the appropriate moisture content. Defective, small, or infested beans are either thrown away or, if possible, sold to licensed cocoa waste buyers.

Table 3.2 Percentage of farmers who agree with the statement: "Bean quality is important for Ghana's cocoa sector".

	Suhum (n=30)	Dormaa Ahenkro (n=30)	Assin Foso (n=30)	Wassa Akropong (n=30)	Total (N=120)
Strongly disagree	10.0	3.3	10.0	0.0	5.8
Disagree	20.0	13.3	20.0	33.3	21.7
Neutral	0.0	3.3	0.0	0.0	0.0
Agree	10.0	46.7	10.0	26.7	23.3
Strongly agree	60.0	33.3	60.0	40.0	48.3

Source: Field data 2010/2011

It is reported for instance that in the 2004/05 season, after six weeks of purchases, only 15% of all cocoa purchased by the Produce Buying Company (an LBC subsidiary of COCOBOD) met minimum quality standards (Kpodo, 2006). In the 2005/06 and 2006/07 seasons, even less than 10% of the cocoa purchased by LBCs

could meet international premium quality standards, because the percentage of cocoa beans with purple instead of chocolate colour was too high (Anim-Kwapong et al., 2007).

Table 3.3 Proportion of light crop and small beans purchased in Ghana, 1999 to 2009

Season	Main Crop	Light Crop	Small beans
1999/2000	87.92	10.50	1.58
2000/2001	84.27	10.86	4.87
2001/2002	88.67	10.28	1.05
2002/2003	76.71	18.83	4.46
2003/2004	71.15	26.59	2.26
2004/2005	68.68	28.41	2.90
2005/2006	70.13	28.25	1.62
2006/2007	81.07	11.44	7.49
2007/2008	82.45	9.91	7.64
2008/2009	98.25	1.58	0.16

Source: COCOBOD, Unpublished data

In Table 3.3, data from COCOBOD on the different categories of cocoa beans purchased in Ghana are outlined. *Main Crop* cocoa beans are bigger in size, while *Light Crop* and *Small Beans* are too small for export. The table shows that over the last ten years, at least 10% of the total volume of cocoa beans purchased from farmers annually are too small to be exported and are, therefore, sold at a discount to domestic manufacturers. The proportion of light crop and small beans was higher between 2002/03 and 2007/08 averaging 25% per annum. It is unclear what explains the very low percentage of light crop and small beans for 2008/09.

3.5 Main causes of the cocoa bean quality problem

Figure 3.1 gives a diagrammatic representation of what we think, after analysing responses from interviews, are important technical and institutional causes of the quality concerns mentioned in the previous section.

3.5.1 Technical explanation of quality problem

Our findings suggest that inappropriate pre- and post-harvest activities are the main technical cause of the quality problem. Table 3.4 presents the views of the sampled farmers on the practices that result in cocoa beans that could not be marketed. Even though the choice of variety of cocoa planted affects the biochemical quality (Dongo et al., 2009), only 7% of the farmers thought that the variety of cocoa tree determines

the final quality of cocoa beans. Table 3.4 also shows that most farmers acknowledged the importance of farm maintenance (95%), appropriate harvesting (89%), good pod storage (83%), fermentation (84%), and drying (71%) in enhancing the quality of cocoa beans they produced. They explained, however, that carrying out all the necessary farm practices required extra costs in terms of time and inputs. It is not always possible for farmers to meet these costs because they do not have adequate incentive to do so.

3.5.2 An information problem

The main reason for this inadequate incentive appears to be that the Ghanaian domestic cocoa market suffers from a number of information asymmetries. Farmers tend to have more knowledge about the production and post-harvest practices they apply, and hence about some aspects of the quality of their cocoa beans prior to sale, than LBCs and COCOBOD. At the same time, farmers lack information about important aspects of bean quality requirement that is generated and shared at levels far above them in the cocoa chain.

Table 3.4 Percentage of farmers who agree that different practices result in poor bean quality

Farm practices	Suhum (n=30)	Dormaa (n=30)	Assin Foso (n=30)	W. Akropong (n=30)	Total (N=120)
Variety type	6.7	13.3	6.7	0.0	6.7
Poor farm sanitation	96.6	100.0	83.4	100.0	95.0
Type of chemicals used	76.7	76.7	46.7	70.0	67.5
Frequency of harvest	96.6	96.6	76.7	86.7	89.2
Length of pod storage	90.0	93.3	70.0	80.0	83.3
Poor pod breaking	93.3	90.0	76.7	100.0	90.0
Poor fermentation	83.4	90.0	76.7	86.7	84.2
Inadequate drying	60.0	66.7	90.0	70.0	71.7

Source: Field data 2010/2011

The asymmetries persist partly because the LBCs and COCOBOD do not have effective mechanisms for monitoring the production process of farmers. High cost of monitoring each farmer's activities could explain the absence of such procedures. The only time farmers' practices are monitored is during the government's mass spraying of cocoa farms, where the supervisors of spraying gangs ensure that farmers have carried out their farm maintenance activities, such as weed removal and pruning of trees, before the farms are sprayed against insects (capsids) and fungal disease (black pod).

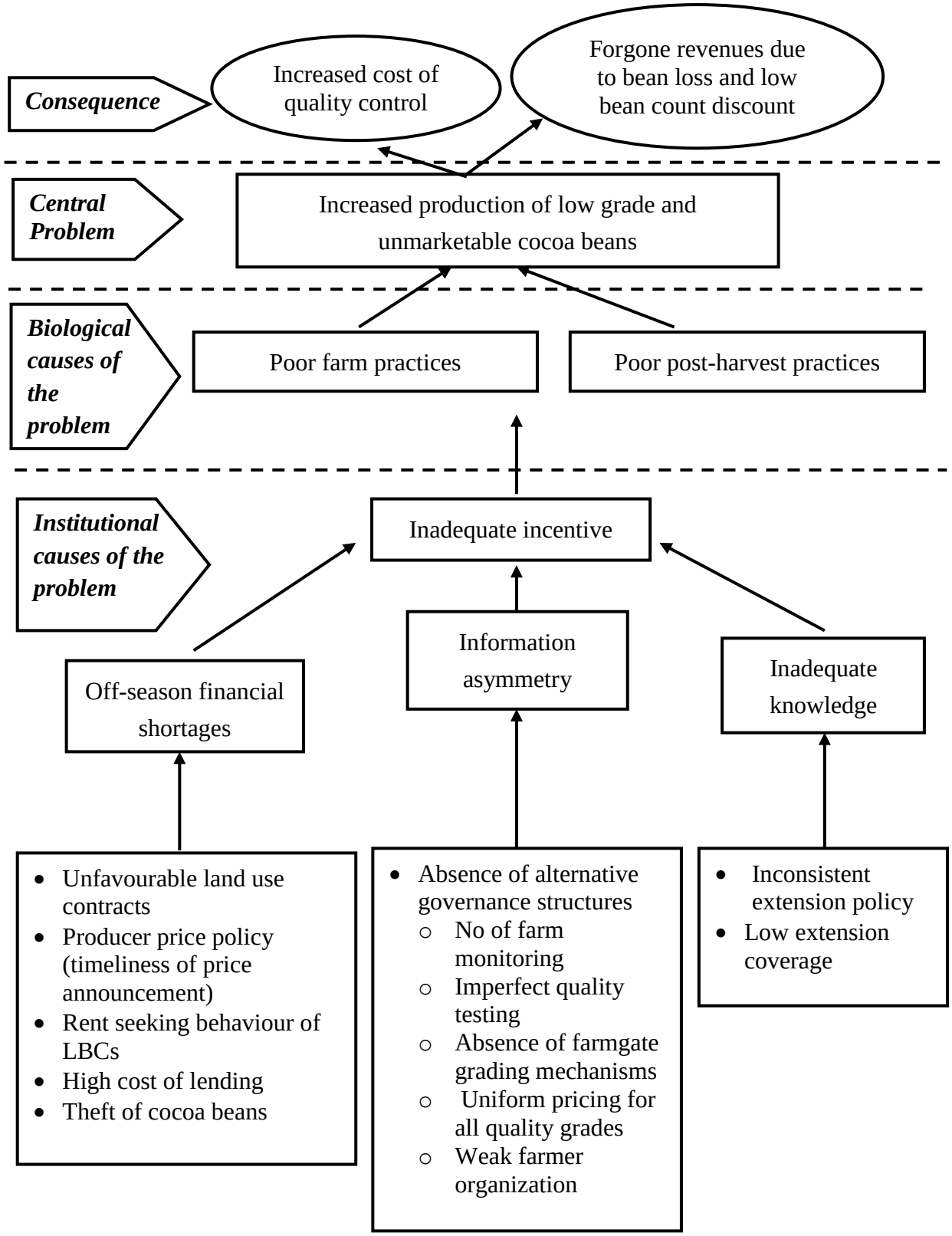

Figure 3.2 Biological and institutional causes of the sub-optimal quality performance of cocoa farmers
Source: Diagnostic Study, 2010/2011

Prior to the 1980s, when cocoa farmers were better organised, the farmers' organizations had rules for monitoring members' practices. The collapse of the farmer organisations throughout the cocoa growing communities arose from political interference, poor organization, and mistrust among farmers that increased during prolonged periods of political turbulence (Ton et al., 2008). Though there is an umbrella cocoa farmers' organisation, called the Ghana Cocoa Coffee Sheanut Farmers Association, the association is active only at national level.

Another explanation for the observed information asymmetry is that in Ghana's cocoa industry, cocoa beans are not graded prior to purchase by the LBCs. It is only after the purchased cocoa beans are bulked, sorted, and evacuated from the farms to district depots, that the strict quality control procedures of COCOBOD takes effect. Meanwhile, because of high competition among the LBCs for farmers' beans, LBCs buy all the cocoa beans offered to them by farmers and recondition them later through drying and sorting. Farmers thus have a high incentive to reduce their costs of production by shirking some of the recommended practices.

3.5.3 A knowledge problem

From the analyses of the focus group discussions with farmers it was observed that, apart from the information asymmetries between farmers and the LBCs, farmers find the linkage between COCOBOD policies and cocoa bean quality to be ambiguous. Farmers did not receive enough training and feedback on many aspects of quality control standards. The merger of the Cocoa Service Division of COCOBOD, which was in charge of the dissemination of information, with the Agricultural Extension Department of the Ministry of Food and Agriculture (what became known as the unified extension system) marked the beginning of the collapse of advisory services to cocoa farmers. Extension officers under the unified extension system were not sufficiently resourced to carry out their information task (Dormon, 2006).

COCOBOD has recently partnered with private sector organizations like Cadbury Plc. to provide extension services to farmers. It is too early to assess the impact on farmer knowledge. However, there is a concern that even with this intervention, the farmer-extension worker ratio remains high. For example, at the time of this study, none of the Cocoa Offices in the sampled districts had more than seven extension agents. This is woefully inadequate, considering that each of these districts had no less than 90 cocoa growing villages.

Table 3.5 Percentage of farmers who are satisfied with different aspects components of COCOBOD's price policies

Price policy Component	Suhum (n=30)	Dormaa (n=30)	Assin Foso (n=30)	W. Akropong (n=30)	Total (N=120)
The price (amount)	60.0	83.3	13.3	70.0	61.6
General price increase	90.0	90.0	76.6	90.0	86.7
Timing of announcement	13.3	30.0	16.6	10.0	17.5
Cocoa bonus	70.0	70.0	60.0	80.0	62.5

Source: Field data 2010/2011

Most farmers interviewed were generally satisfied with COCOBOD's price policy (as is shown in Table 3.5). Apart from the amount paid per bag of cocoa, the expectation of annual price increments gives the farmers the assurance that their demands are being recognized even though they were mostly not comfortable with the inconsistent timing of price announcement. As part of their price policy, COCOBOD insures farmers against world price volatility by selling cocoa in forward markets. Windfalls are paid to farmers as bonuses. Farmers do not see the current bonuses paid to them as in any way related the quality of their beans.

3.5.4 An income problem

A seemingly favourable price policy environment notwithstanding, farmers are faced with an income problem that sometimes makes them reluctant to invest into quality-related activities. It is instructive to illustrate this economic problem confronted by farmers by way of a numerical example. In line with the data from our survey and other national estimates, suppose an annual output of 250kg per hectare and an annual labour requirement of 80 working days per hectare (Abenyega and Gockowski, 2003; Opoku-Ameyaw et al., 2010; Teal et al., 2006). Also suppose that, again in agreement with what we found, about 40% of this labour requirement is hired at the cost of US$ 3.57 per day; 10% of this labour requirement comes from non-paid sources like family and reciprocal labour; and the remaining 50% is farmers' own labour. In the 2010/11 season, the price per kg of cocoa beans stood at US$ 2.23. Since the government provides chemical spraying for crop protection throughout the cocoa belt, the farmer pays only for the cost of hired labour.

Suppose a farmer crops one hectare of cocoa farm. There are three types of farmers: those who own their land (owner farmer), tenants, and caretakers. Each of them earns the same revenue:

$$250 \times US\$2.23 = US\$557.50$$

The accounting profits – revenue minus explicit costs (out-of-pocket costs) – depend on the type of farmer.

Owner. Since 40% of his labour requirement is hired (i.e. 32 days), we find for his accounting profit (*AP*)

$$AP(owner) = US\$557.50 - 32 \times US\$3.57 = US\$443.26$$

Tenant Farmer. He is always tied to the *Abunu* (fifty-fifty share cropping) land use contract. His explicit costs include payment for hiring of labour and, under the *Abunu* land use contract, half of his output as rent. Therefore,

$$AP(tenant) = US\$557.50 - 32 \times US\$3.57 - {}^{1}/_{2}\, US\$557.50 = US\$164.51$$

Caretaker. He is always contracted under the Abusa land use contract where they earn a third of the output. His explicit costs are even larger, since under the *Abusa* land use contract two-third of the output is paid as rent, so

$$AP(caretaker) = US\$557.50 - 32 \times -{}^{2}/_{3}\, US\$557.50 = US\$71.59$$

However, the relevant income yardstick is not accounting profit but economic profit, which also takes account of implicit costs for farmers. Implicit costs are captured by the wage income a farmer could have earned by working on someone else's farm or in another form of employment. Since 50% of the farm labour requirement consists of farmers' own labour, each type of farmer has an implicit cost of

$$40 \times US\$3.57 = US\$142.80$$

Moreover, an owner could also rent out his land, so he has an additional implicit cost of

$${}^{1}/_{2}\, US\$557.50 = US\$278.57$$

if he rented his land under the Abunu system, and

$${}^{2}/_{3}\, US\$557.50 = US\$371.67$$

under the Abusa system.

In sum, if we assume that farmers always have the opportunity to hire themselves out or to rent out their own land, then an owner farmer earns an economic profit of U$ 21.71 (443.26 - 142.80 - 278.75) if he would give his land for rent under the Abunu system or, in the case of the Abusa system, an economic loss of US$ 71.21 (443.26 - 142.80 - 371.67). A tenant farmer earns an economic profit of US$ 21.71 (164.51 - 142.80); whereas a caretaker always make an economic loss of US$ 71.21 (71.59 – 142.80) The example illustrates the fragile basis of farmers for undertaking quality-related investments. Although the assumptions may be oversimplified, it illustrates the fact that without adequate price and non-price incentives most farmers, who are tenants and caretakers, will be unable to carry out the recommended practices, although they may know what these are.

This constraint arises from the financial losses farmers seem to be making due to relatively low revenue compared to other uses of their labour and high cost of renting land. Also poor financial services to cocoa farmers, because of the perceived high risks associated with lending to farmers, and the absence of alternative sources of income during off-season periods affect farmers' financial position and contribute to this income problem.

Two other key issues can be mentioned that affect the financial position of farmers. First, during the interviews and focus group discussions, it emerged that the timing of announcement of producer prices was not consistent, and often prices are announced too late in the year. Cocoa purchases are halted in June each year. A Producer Price Review Committee (PPRC) announces the new prices that will be paid at the commencement of cocoa bean purchases between September and October each year. Farmers begin harvesting by end of July and sometimes have to sell their cocoa beans at the prices of the previous year between July and October due to delays in announcement of new prices. This represents a considerable loss of income to them since the new prices up till now have always been higher.

Secondly, rent-seeking activities of competing LBCs affect farmers' financial position. An example is the adjustment of weighing scales in order to obtain more cocoa beans from farmers at the going price. Some farmers and LBCs interviewed mentioned that there is the so-called "official Accra weight", which is the Producer Price Review Committee' (PPRC's) unit of 64kg per bag, and the "village weight" used by the LBCs, which varies between 65kg and 70kg per bag. Farmers have not been able to negotiate their way out of this unfortunate position, probably because they are weakly organised. LBCs argue that the extra revenue accrued from the adjusted scales covers the risk they have to bear when they purchase cocoa beans of low quality from farmers.

3.6 Discussion and conclusions

3.6.1 Institutions and actor interactions towards quality

Problems related to commodity quality are often attributed to information asymmetry (Akerlof, 1970; Hueth et al., 1999; Kherallah and Kirsten, 2001). The information asymmetry problem is easier to understand when one analyzes the interactions among the three main sector actors who ensure the movement of cocoa beans from the farm to the chocolate manufacturer – Farmers, LBCs and COCOBOD. Hueth *et. al.* (1999) posit that when incentive problems affect the quality of agricultural commodities, then input control, field visits, quality measurement, and general price increases are the best institutional mechanisms to coordinate the interaction between actors in order to ensure quality (Holmström and Milgrom, 1994; Laffont and Martimort, 2002). Two interactions seem to be particularly important here: between COCOBOD and farmers, and between LBCs and farmers.

The relation between COCOBOD and farmers can be best described as paternalistic. The farmers consider themselves as the recipients of policies, technologies and inputs from COCOBOD, and have minimal participation in the decision making processes. Because farmers do not supply cocoa beans directly to COCOBOD, the latter relies solely on reciprocity by designing a number of benefiting policies and hope that farmers will respond by supplying quality cocoa beans. COCOBOD regulates all the chemical inputs imported into the country for use on cocoa farms even though sometimes, unapproved chemicals have found their way to the market for farmers' use. Also, COCOBOD uses part of the export revenues from cocoa to carry out mass-spraying of all cocoa farms in Ghana at least twice per season. The mass-spraying exercise has been expanded since the 2008/09 season with the introduction of chemical spraying of folial liquid fertilizers, in addition to pesticides and fungicides. The mass-spraying policy helps to reduce the information problem because the majority of cocoa farms are treated with the right chemical at least once a year. However, the chemical application exercise does not effectively tackle the pest and diseases aspect of cocoa bean quality because it is calendar-based and not need-based. It was also observed during this study that the mass-chemical-spraying policy faces such challenges as fraudulent diversion of approved chemicals, inefficient application techniques by spraying gangs, use of chemical application schedules that does not follow COCOBOD recommendation and political interference among others.

Price policy has been used to coordinate the interactions between COCOBOD and farmers. Pricing is used to structure incentives in the cocoa sector because cocoa supply responds positively to prices. The PPRC, which has the responsibility of fixing cocoa producer prices has problems with making the voices of the farmers heard even

though farmers are represented on this committee (Vigneri and Santos, 2008). Farmer representatives have indicated that they are sometimes not adequately briefed about the methods used to determine prices. Over the years, there have been two modes of setting cocoa prices in Ghana. Prior to cocoa sector reforms in the 1990s, the price policy involved payment of a price that was equivalent to the estimated cost of production plus a profit margin. Presently, the pricing is based on a calculated percentage of the freight on board (f.o.b) price that Ghana receives from exporting cocoa beans. Even though the PPRC has increased the price paid to cocoa farmers from 23.3% of the f.o.b price in 1983/84 to up to 73% in 2008/2009, it is not known which of the two modes provides sufficient motivation to farmers to want to enhance quality of cocoa beans further.

Under the current price policy, the information problem in the cocoa sector seems difficult to solve. In principle, a combination of testing and price differentiation could initiate a self-selection process where farmers would be discouraged to supply low-quality beans and encouraged to produce and sell high-quality beans. From the perspective of COCOBOD, quality is factored into the pricing formulae since its licensed buyers purchase only premium quality cocoa. Furthermore, the two quality grades from Ghana are marketable as premium cocoa on the international market. Hence, COCOBOD does not seem to have the incentive to differentiate prices as long as they can be sure of a sufficient volume of quality beans. It is true that the LBCs may have an incentive to differentiate prices in order to increase the volume of quality beans they buy from farmers, yet the cocoa marketing rules do not give much room for LBCs to implement such a price policy. This is because LBCs do not receive a differentiated price from COCOBOD.

There are other policies introduced by COCOBOD to provide incentives to cocoa farmers to improve their production. These include an input credit programme (the so-called hi-tech scheme), a 45% fertilizer subsidy, annual scholarship grants for about 2,600 children of cocoa farmers and staff of COCOBOD, and flexible house mortgage schemes. These policies, however, do not help to reduce the information asymmetries in the sector. Also, the majority of farmers are not able to access benefits of these policies because they either are smallholders or do not own the cocoa farms they crop (sharecroppers). House mortgage schemes are for instance too expensive for smallholder sharecroppers. Apart from the fact that only 40% of farmers' children benefit from scholarships, some of the criteria for accessing cocoa scholarships are often not favourable for farmers' children. For example, examination results of children in village schools in Ghana, which are attended by farmers' children, are often too poor to meet the pass mark to access cocoa scholarships.

Information asymmetry is more persistent in the interaction between farmers and LBCs, than between farmers and COCOBOD since farmers supply their beans straight to LBCs. Prior to the reforms of the 1990s, only the Produce Buying Company, a subsidiary of COCOBOD, purchased cocoa beans. While this monopoly had its socio-economic concerns, it was accompanied with a mechanism where farmers' cocoa beans were closely inspected and a premium was paid for quality. This partly explains the high quality status Ghana enjoyed in the years preceding the reforms. The introduction of more LBCs since the reforms brought a weakening of the mechanism for bean quality checks and enforcement in villages. This provided room for rent-seeking activities of LBCs and undermined the usefulness of quality premia. Presently LBCs have little or no mechanisms to ensure that farmers stick to recommended practices. The real concern with farmer-LBC interaction is that LBCs are merely profit-seeking agents of COCOBOD. Since the rules regarding marketing cocoa beans give the LBCs little room to independently tackle the information problem, they have not done much in this regard.

3.6.2 Institutional gaps and opportunities for future experimentation

Carrying out a diagnostic study on the institutions governing the interactions in a public-interest sector like cocoa is often characterized by difficulties in data acquisition. Also, it is difficult to point out some of the shortcomings of the sector when Ghana has a high reputation for export of quality beans. These difficulties notwithstanding, the study has showed that COCOBOD's policies have provided some incentives to farmers towards enhancing quality, but these policies only partly reduced the information asymmetries among cocoa farmers, LBCs, and COCOBOD. This is the real reason why some farmers shirk the responsibility of adopting the recommended production and postharvest management practices.

Currently mechanisms that will expose farmers who do not stick to recommended practices are simply missing. These gaps in policy represent opportunities for institutional change that could help reduce the information problem and at the same time provide cocoa farmers remunerative rewards for their activities. The original entry point of the COS-SIS cocoa domain research was sustaining the quality of cocoa beans produced in Ghana through improvement in the incentive structures. This diagnostic study suggests that the appropriate development of self-selection mechanisms, such as quality testing with price premia at farm gate, could overcome the negative impact of the existing information asymmetries in the cocoa sector. It is also suggested that future studies take into account the influence of farmer organization and networks on member farmers' production practices.

Another possible institutional change is to make the cocoa price policy formulation process more transparent and to reduce the ambiguities in the relation between pricing and quality. Exploration of the economic, social and quality impacts of different modes of pricing can also provide useful insights into price policy options to enhance cocoa bean quality. As these sort of institutional changes are above farmer level, they should be tackled by activities such as the Concertation and Innovation Group (CIG) on cocoa that is convened by the CoS-SIS programme.

Above farmer-level institutional changes will require evidence and feedback from the farmer-level experimentation. Experiments with alternative incentive structures for farmers, which could be part of our on-going (PhD) research, could provide information about cost-effective strategies for enhancing cocoa bean quality. Experimentation will also provide insights on how farmers will respond, in terms of quality and quantity, to the introduction of alternative pricing mechanisms into the local cocoa market. As demonstrated in this chapter, one missing element in Ghana's cocoa market is a self-selection mechanism (price differentiation with test-cum-fee) at farm gate.

3.6.3 Conclusions

This chapter reports on the findings of a diagnostic study conducted on the cocoa sector in Ghana to investigate which institutional factors act as a disincentive for farmers to enhance the quality of cocoa beans. The concept of cocoa bean quality is a complex phenomenon, encompassing socio-economic, physical, and bio-chemical properties as well as the process of cocoa production. Due to the relative ease of observing physical characteristics, both domestic and international markets place emphasis on physical quality.

The study has highlighted the fact that Ghana exports only premium quality cocoa beans. However, the volume of high quality beans can further be increased if farmers would be motivated to enhance the quality of harvested cocoa beans. The study found that sometimes farmers are unable or unwilling to invest resources into recommended farm practices because there are often little or no incentives to do so.

The key explanation of this lack of incentives is that the interaction among farmers, LBCs and COCOBOD is characterized by problems of information asymmetry. The absence of farm monitoring, grading, and strong farmer organizations explain this information problem. Also, farmers are faced with an income problem off-season that hampers investment of any kind, and the fact that farmers have only little knowledge of recommended farm practices and of COCOBOD policies with respect to quality further acts as a disincentive.

Current policies of COCOBOD have not adequately addressed the problem of low incentives, especially in the interaction between farmers and LBCs. This policy gap presents an opportunity for socio-economic, biological, and institutional experimentation with alternative policies at farmer level and above-farmer level that might lead to institutional improvements in the cocoa sector of Ghana. Such institutional changes are likely to open windows for farmers to remuneratively enhance the quality of the cocoa beans they produce.

Chapter 4

Farmer participatory research and adoption in smallholder Ghanaian cocoa farming

4.1 Introduction

Consistent export of premium quality cocoa beans has given Ghana an excellent reputation in the chocolate and confectionary market. However, sustaining the delivery of this premium quality has proven to be a challenge. Ghana's cocoa governing board (COCOBOD) upgrades its quality standards periodically, and expenditure on quality control activities has increased by over 35% in the last decade (Amoah, 1998; Pinnamang-Tutu and Armah, 2011; Kolavalli *et al.*, 2012). In spite of these efforts, the question remains whether at the current production level, farmers can do more to enhance the quality of their produce (Adzaho et al., 2010; Williams, 2009; Laven, 2010).

Scientists have recommended a number of specific farm and post-harvest practices that aim to improve cocoa bean quality, collectively referred to as Good Agricultural Practices (GAPs) (Anim-Kwapong et al., 2007; Gilmour, 2009). The rate of adoption of the recommended GAPs by Ghanaians farmers is below expectation (Aneani F. et al., 2012; Ayenor et al., 2004). Literature suggests that if farmers have adequate knowledge about these recommended innovations, they are more likely to adopt them (Assis and Mohd, 2011; Erbaugh et al., 2001; Jalal-Ud-Din, 2011; Rogers, 1995; Shahnaj, 2010; Tripp et al., 2005). It is further argued that a participatory approach to innovation development can significantly improve farmers' knowledge and increase the adoption of jointly developed technologies (Biggs, 2007; De Jagger et al., 2004; Röling, 2009; Röling and Wagemakers, 1998). Contrary to a linear conventional extension (CE) approach, where farmers are only end-users of technology, participatory methods allow farmers to contribute their indigenous knowledge to the development of new technologies and test and adapt them to their own conditions (Bartlett, 2008; Lilja et al., 2011). In this chapter, we evaluate the effectiveness of farmer participatory research relative to conventional extension methods with respect to increasing the knowledge of farmers about GAPs and the likelihood of farmers to adopt these practices.

Generally, farmer participatory research methods have been found to significantly influence farmer knowledge and adoption behaviour (Dalton et al., 2011; Daniel et al., 2011, Misisko et al., 2008). Regarding Ghana's cocoa sector, only a few studies have dealt with the impact of participatory research. E.g. Wiredu et al. (2011)

found a positive relationship between adoption of recommended practics and involvement in participatory research programmes. Braun et al. (2006) and Soniia and Asamoah (2011) found that farmers who participated in farmer field schools improved their knowledge on cocoa practices and afterwards adopted some innovations they had learned. Ayenor et al. (2007) challenged the extent of farmer involvement generated by farmer field schools and explored the effectiveness of Local Agricultural Research Committees (LARC) (see also Ashby et al., 2000). Here cocoa farmers in an experimental learning group are actively engaged in a systematic evaluation of alternative innovations on their own fields, and provide feedback to the rest of the community. They found that, compared with non-exposed farmers, LARC and exposed farmers significantly improved their knowledge, adoption and diffusion of technologies.

Farmers' participation in agricultural research has not always yielded positive adoption results (Bentley, 1994; Hall and Nahdy, 1999). Hounkonnou et al. (2012) argued that adoption by participating farmers is usually limited by institutional factors that tend to be beyond their control. Dormon et al. (2007) demonstrated that institutional bottlenecks prevented participant cocoa farmers in Ghana from adopting even the most profitable technologies.

A peculiar institutional bottleneck in Ghana's cocoa sector is the organization of the cocoa market, where cocoa is not graded when purchased from farmers and, hence, all quality grades attract the same price (Quarmine et al., 2012). Economists argue that under such market conditions farmers will have little incentive to improve the quality of their cocoa beans if that would require more effort from them. Sociologists contend, however, that even if market conditions are unfavourable, farmers may be willing to adopt quality-improving technologies so long as it suits some social objective, such as enhancing their reputation or social status (Leiter and Harding, 2004; Long, 2001; Granovetter, 1985). The question which then arises is: given that cocoa is not graded when purchased from farmers and sells a uniform price for all quality grades, will farmers who have taken part in participatory research activities enhance their cocoa bean quality, and if so, why?

To address this question, we conducted a farmer participatory research (FPR) experiment in the Suhum Cocoa District between February 2011 and February 2012, where farmers and other stakeholders collectively tried recommended cocoa bean quality-enhancing GAPs. The following research issues were addressed: (1) How effective are recommended GAPs in improving cocoa bean quality? (2) Do farmers learn more about recommended GAPs through participatory methods (FPR) compared to conventional extension (CE)? (3) Are farmers who took part in FPR more likely to adopt recommended GAPS than those involved in CE training?

4.2 Materials and Methods

4.2.1 Experimental set up

The FPR experiment was two-tiered. First, we tested the effectiveness of a set of GAPs, as recommended by Cocoa Research Institute of Ghana, with respect to their ability to enhance cocoa bean quality and their economic desirability in terms of costs and benefits. If farmers are to adopt any technology, they need to verify its effectiveness for themselves. This was done jointly with farmers on a proportion of their own fields in 'FPR communities'. It involved comparing outcomes (yield and quality) from plots managed with GAPs and plots of farms using conventional approaches, i.e. Farmers' Practices (FPs).

The second tier of the experiment compared the knowledge and bean quality of farmers who took part in FPR (FPR farmers) with that of farmers who learned GAPs with conventional extension methods (CE farmers). The latter farmers were drawn from communities assigned as 'CE communities', where conventional extension officers were teaching GAPs (but not using participatory learning plots) during the FPR experiment. Note that at the start of the FPR experiment, new extension officers had been freshly assigned to the various communities after almost a decade of breakdown of public extension services in Ghana (Dormon, 2006; Laven, 2010). Hence, the CE and FPR farmers were comparable in terms of their exposure to extension services.

4.2.2 Study area

The research was carried out in the Suhum Cocoa District. The district was selected because of its potential for cultivating cocoa with low-external-input technologies. It is characterized by a bi-modal rainfall pattern with an average of 1,270 mm to 1,651 mm per year, an average daily temperature between 24°C and 29°C, and a relative humidity between 87% and 91% (Dormon, 2006).

4.2.3 Experimentation process

The FPR experiment began with a series of key informant discussions with officers of the Cocoa Extension Unit of the Suhum Cocoa Office. These meetings helped to understand the structure of the district and the characteristics of its cocoa communities. With the aid of extension officers, ten communities with at least one established farmer based organization (FBO) were purposively sampled. The new extension officers worked either with already existing FBOs or with FBOs they had initiated themselves. Hence, for comparison purposes, we worked with farmers organized in FBOs in both FPR and CE communities. Next, a series of meetings were held with the selected (new or old) FBOs, where the question of low farmer knowledge was

discussed. At these meetings, current Farmer Practices (FPs) were identified and also a suitable system of quality-enhancing GAPs was constructed, based on ideas from farmers, staff and documents from Cocoa Research Institute of Ghana (CRIG), and the literature (see Table 4.1). In the end, six FBOs -- one per community -- were selected for the experiment. Five of the FBOs were already established while one of them was in the process of formation. They were chosen on the basis of having at least 30 members who were willing to participate in the experiment. The six selected communities were at least 5 km apart to avoid contamination. The 'FPR communities' selected for the experiment were in the villages Duodukrom, Kuano and Asuogya, while the 'CE communities' were in the villages Tei Mensah, Tete Kasum and Otwe.

In each of the three CE communities farmers learned GAPs through the conventional extension system. In this system, extension officers formed or identified FBOs and subsequently trained all members during group meetings on GAPs as recommended by Ghana's Cocoa Research Institute. The CE training method also included field visits to interact with individual farmers and to address their specific technical information needs.

In each of the three FPR communities, we set up six 90 meter square plots reasonably distant from each other. Three of these plots were randomly assigned to GAPs and the other three to FPs. The FBO selected the farms where these six plots were to be demarcated based on their own internal democratic procedures. The biotic characteristics of the 18 plots were similar. Plots were jointly treated and reviewed regularly from February 2011 to February 2012 by all stakeholders in the experiment – farmers, research scientists, extension officers, and cocoa buyers – under controlled experimental conditions. After plot treatments and discussions, farmers were expected to try, on their own farm, specific practices that they found useful and maybe wished to adopt in the future. Researchers and extension officers took care not to interfere with the decisions of farmers to do these try-outs. Regarding our strategy for measuring adoption, we did not expect farmers to have fully gone through the adoption process over the one-year period of the experiment. However, we assumed that farmers would be in the initial stages of such a process when they would try out recommended technologies under their own conditions, make adjustments, and bring up any issues for discussion at FBO level where other stakeholders could make suggestions. The assumption here was, therefore, that the more novel practices a given farmer tries out on his/her own field, the more likely this farmer will adopt GAPs in the near future.

Table 4.1 Description of Good Agricultural Practices (GAPs) and Farmer Practices (FPs)

Treatment	Stage	Activities
GAPs	Pre-harvest	NPK fertilizer; IPM[(i)]; discard all black pods outside farm; regularly prune, remove chupons and mistletoes monthly; weed four times per season; harvest fortnightly, harvest only ripe pods
	Post-harvest	Two days pod storage, discard all unhealthy beans, ferment for seven days with two turnings, dry and polish to 8% moisture.
FPs	Pre-harvest	CODAPEC folia fertilizer only; CODAPEC[(ii)] spraying of insecticide only; leave black pods on the ground on farm; prune, remove chupons and mistletoes twice in the season; weed twice per season; monthly harvest; harvest both ripe and unripe pods
	Post-harvest	Four days pod storage; healthy and unhealthy beans can be fermented together; at most five days fermentation; no strict rule for turning fermentation heap; dry to any moisture content of choice

Notes: (i) Integrated Pest Management (IPM) is, in its simplest form, a control strategy in which a variety of biological, chemical, and cultural control practices are combined to give stable long-term pest control (Ramalho, 1994). (ii) CODAPEC denotes a cocoa disease and pest management programme that involves mass-spraying of all cocoa farms in Ghana at least once in a year.

To evaluate the impact of research participation on farmer knowledge and subsequent use of these technologies on their fields, FPR farmers were compared with CE farmers. The FPR approach to farmer learning differed significantly from CE because it enabled farmers to learn GAPs hands-on in a participatory environment and be directly involved in creating the knowledge. Through an interactive process, farmers in FBOs, extension officers, research scientists, and cocoa buyers collectively discussed, selected, tried and evaluated appropriate technologies that could improve yield and crop quality.

4.2.4 Data from the field survey

Two sets of data were collected for this study. First, plot-level data from the FPR communities were collected. For both GAPs and FPs plots, we recorded quantitative information on plot bio-physical characteristics, yields, cocoa pod health, cocoa pod counts, and cocoa bean physical quality, and also qualitative information on treatment

activities throughout the experiment period. Second, panel data on demography, farm practices, knowledge, and cocoa bean quality related to 60 FPR and 60 CE farmers were collected using a semi-structured questionnaire before and after the experiment. Sampling of the 120 farmers started with clustering the members of each of the six FBOs by land use contract of their main cocoa farm. Using simple random techniques, six *owners*, seven *abunu*, and seven *abusa* farmers were selected from each FBO.[1] Land use contract was used as a clustering criterion because it is likely to influence farmer behaviour (Takane, 2000).

4.2.5 Empirical analyses

Descriptive statistics, involving means, were used to compare the cocoa bean yields and quality scores from FPs and GAPs plots in order to evaluate the effectiveness of GAPs. To assess the economic desirability of cropping cocoa with GAPs, we compared the total profits of GAPs and FPs per hectare, expressed in US$ (1 US$ = GH¢1.72 in February 2011). Since we are considering smallholder farmers, these profits are unlikely to vary with the number of hectares. For calculating the revenues per hectare, the cocoa price was set at US$ 1.86. Total costs per hectare related to hired labour time and any chemical inputs used on both fields. Labour costs were calculated by using the daily wage of a hired worker (US$ 4.09).

We measured the difference in knowledge and cocoa bean quality (from own plots) between FPR farmers and CE farmers as follows. The active participation of farmers in the treatment of experimental plots and the joint review of outcomes with other farmers and researchers was expected to increase FPR farmers' knowledge about GAPs more than their CE counterparts. Similarly it was expected that FPR farmers would try out more novel practices on their own plots than CE farmers, and so would produce a higher bean quality. Factors that could have had confounding effects on farmer knowledge and self-produced bean quality were demographic and FBO characteristics, so we controlled for them. The change in knowledge (or in bean quality) of farmer *i* after the learning process was modelled as

$$\Delta Y_i = \alpha + \beta P_i + \gamma X_i + \delta Z_i + \mu_i \qquad (1)$$

where ΔY_i is the change in target variable (knowledge score or bean quality score) before and after a farmer *i* participated in the experiment. P_i is a dummy variable, being equal to 1 if *i* was an FPR farmer and 0 if he or she was a CE farmer. X_i and Z_i represent vectors of personal and FBO characteristics. Coefficients α, β, γ and δ are

[1] *Owners* are farmers who own most of the lands they cropped. *Abunu* farmers are tenants who share their produce equally with the owner of the land they cropped. *Abusa* farmers are hired workers or caretakers who are paid a third of the produce from the farm.

regression parameters to be estimated; μ_i is a random error term. Coefficient β captures the impact of learning through FPR on outcome variables. We tested the null hypothesis, $\beta = 0$: learning through FPR or through CE does not make any difference with respect to what is learned and what is applied on own fields.

Knowledge scores were obtained by asking farmers a set of thirteen equally weighted questions about how to obtain good quality beans and calculating the number of correct answers as a percentage of the total number of questions. Bean quality scores was measured by taking the proportion of non-defective cocoa beans. Cocoa beans ready for sale should not be mouldy, slaty (dark-grey), germinated, purple in colour, insect-damaged, decayed, chipped, or too small in size. In addition, quality cocoa beans ought to be well fermented and thoroughly dry (Dongo and Sogwa, 2009). On monthly basis, a sample was taken from the ready-for-sale beans on each GAPs and FPs plots as well as CE and FPR farmers. This monthly sample was divided into four lots, and from one, 100 beans were randomly selected without replacement and cut into two halves. One half of every cut bean was assessed for defects. The other half of each bean was discarded. The number of bad beans (purple cotyledon, slaty or black, mouldy, germinated, insect-damaged, cut seed coat, etc.) were counted and deducted from 100 to determine the percentage good quality score. The process was repeated three times for each farmer and the average is recorded.

4.3 Results

4.3.1 Effects of GAPs on Cocoa Yields and Quality

Concerning the GAPs trials on the plots in the FPR communities, quantities and mean cocoa bean quality scores from FPs and GAPs plots are compared in two cropping seasons: 2010/11 (February 2011 to June 2011) and 2011/12 (July 2011 to February 2012) (Table 4.2A). During the 2010/11 cocoa season, when we started the experiment, yields from GAPs and FPs plots were 355 $KgHa^{-1}$ and 290 $KgHa^{-1}$, respectively. After one calendar year of experimentation, GAPs plots yielded a total output of 1104 $KgHa^{-1}$compared with 743 $kgha^{-1}$ on FPs plots. The following cropping season (2011/12), yields from GAP plots (749 $kgha^{-1}$) were higher than FPs plots (453 $kgha^{-1}$). Mean quality scores from FPs plots remained almost constant over the experimentation period between 68%, and did not significantly differ from the baseline score (Table 4.2A). Mean quality scores from GAPs plots increased from 68% to 85% over the experimental period, and differed significantly in both seasons from the FP plots with scores of 71%. The main physical quality problem resulted from cocoa beans with purple-coloured cotyledons. Cocoa beans that are properly grown, harvested, fermented, and dried should give brown-coloured cotyledons instead of purple. Other physical defects like slatiness (darkened cotyledons), insect damage, cut

bean coats, mouldiness, and germination appeared in less than 3% of the total sample for both GAPs and FPs.

Table 4.2A Total yields and mean quality scores from FPR experimental plots

		GAPs	FPs
Yield (kg ha^{-1})	2010/11 season (Feb. – June 2011)	355	290
	2011/2012 (July 2011 – Feb. 2012)	749	453
	Total yield after one calendar year	1104	743
Average Quality(1)	Baseline (Jan. 2011)	68.4	68.6
	2010/11 season (Feb. – June 2011)	84.9	71.4*
	2011/2012 (July 2011 – Feb. 2012)	85.2	71.0*

Notes: (i) Average quality is a score between 0 and 100.
* Significant ($p < 0.05$) differences between GAPs and FPs

Table 4.2B Yields and mean quality scores from plots in FPR plots and farmers own fields

Yield (kg ha^{-1})		FPR farmers	CE farmers	Difference
	Before experiment	189.4	229.3	39.9
	After experiment	237.8	246.9	9.1
	Difference	48.4	17.6	30.8*
Average Quality	Before experiment	69.9	68.8	1.1
	After experiment	74.9	70.7	4.2*
	Difference	5.0	1.9	3.1*

Notes: (i) Average quality is a score between 0 and 100.
* Significant ($p < 0.05$) differences between rows FPR and CE farmers

Comparing profits per hectare of producing cocoa over one calendar year, revenues with GAPs were almost double that of FPs, because of higher yields (Table 4.3). Yet labour costs with GAPs were almost twice as high as those with FPs, and the former practices also required large expenditures on chemical inputs. It implies that total costs with GAPs were more than two and a half times higher than total costs with

FPs. Which production technology provides the highest profits, therefore, critically depends on the prevailing price of cocoa, and the actual costs of labour and inputs. GAPs imply higher profits if the price of cocoa per kilogramme is greater than US$ 1.62. At a cocoa price of US$ 1.86, profits per hectare with GAPs were about 8 percent higher than with FPs (labour and input costs being similar).

4.3.2 Impact of participating in FPR experiment

Having evaluated the effectiveness of GAPs, this section compares FPR farmers with CE farmers with respect to gains in farmer knowledge, yields and improvements in bean quality scores on their own farms. Before comparing knowledge and quality scores of the two groups of farmers, we tested whether there existed any significant differences between them in terms of demographic and group characteristics.

4.3.3 Demographic and FBO characteristics of farmers

Apart from household size, source of non-cocoa farm income, and some FBO characteristics, there were no significant differences in the demographic characteristics of FPR and CE farmers (see Table 4.5). The majority of FPR farmers obtained their main non-cocoa farm income from cultivation of other crops, while CE farmers earned additional income from trading (part-time farmers). FPR farmers reported an average number of five persons per household, CE farmers eight. The need for inputs dominated the reasons why farmers joined FBOs. The majority of FPR farmers wanted direct access to inputs, whereas CE farmers joined FBOs to gain access to credit for buying farm inputs. At baseline, FPR farmers more frequently reported strong cooperation and reciprocity among members of their FBOs than CE farmers. In subsequent analyses, we controlled for these differences by including these factors as variables in the regression models.

4.3.4 Impact of FPR on knowledge scores

Overall knowledge scores improved over time by about 17% for FPR and about 8% for CE farmers (Table 4. 6). The significant difference in scores of about 9% can thus be attributed to taking part in FPR. Specifically, knowledge scores were obtained on pre- and post–harvest activities. With regard to pre-harvest knowledge, FPR farmers recorded an additional knowledge score of 20% over the period of the experiment, while CE farmers recorded a gain of almost 10%. Taking part in FPR therefore led to a significant increase in knowledge score of almost 11%. FPR farmers recorded significant improvement in knowledge score for all pre-harvest quality-enhancing activities. CE farmers gained significant pre-harvest knowledge scores over time for pod health, pest damage, and chemical usage (Table 4.6).

Table 4.3 Profits per hectare under GAPs and FPs

	GAPs	FPs
Revenue (US$/ha)		
Output ($kgha^{-1}$)	1104	743
Price of cocoa per kg (US$)	1.86	1.86
Total revenue	*2053.4*	*1382.0*
Costs (US$/ha)		
Pre-harvest labour cost	391.8	165.9
Post-harvest labour cost	314.2	201.2
Chemical input cost	247.1	0.0
Total labour cost	*706.0*	*367.1*
Total costs	*953.1*	*367.1*
Profits (US$/ha)	*1100.3*	*1014.9*

Note: All values in US**$;** 1 US$ = GH¢1.72)

Table 4.4 Mean farmer knowledge scores on pre-harvest and post-harvest activities before and after the FPR experiment [(i)]

		FPR farmers (N=60)	CE farmers (N=60)	Difference
Pre-harvest	Before	54.3 (2.9)	57.1 (2.9)	- 2.8
	After	74.5 (1.5)	66.7 (2.6)	7.8
	Difference	20.2 (2.4)	9.6 (1.7)	10.6*
Post-harvest	Before	65.7 (3.1)	71.0 (3.0)	- 5.3
	After	78.0 (2.6)	76.0 (2.8)	2.0
	Difference	12.3 (2.3)	5.0 (1.6)	7.3*
All questions	Before	59.0 (2.3)	63.0 (2.2)	- 4.0
	After	76.0 (1.4)	70.6 (1.8)	5.4
	Difference	17.0 (1.8)	7.6 (1.3)	9.4*

Notes: (i) Knowledge score range from 0 to 100. Standard errors in parentheses.
* Significant differences ($p < 0.05$) between categories or rows.

For post-harvest activities, the estimated changes in knowledge scores were 12% and for FPR and 5% for CE farmers, a significant increase in post-harvest knowledge of 7% that could be attributed to taking part in FPR (Table 4.4). FPR farmers showed significant improvement in knowledge scores for pod breaking and management of fermentation heaps. CE farmers recorded a significant increase in knowledge scores for number of days of storing cocoa pods (before beans are extracted from them) (Table 4.6).

Table 4.5 Demographic and FBO characteristics of respondents

	FPR farmers (n=60)	CE farmers (n=60)	Statistics[(i)]
Gender (%)			
Male	78.3	70.0	χ^2 =1.08
Female	21.7	30.0	
Marital status (%)			
Married	76.7	78.3	χ^2 = 0.06
Separated	16.7	15.0	
Never married	6.6	6.7	
Migration status (%)			
Indigene	46.7	45.0	χ^2 = 0.034
Migrant	53.3	55.0	
Non-cocoa income (%)			
Non-cocoa farm	41.1	20.8	χ^2 = 9.73*
Processing	10.7	9.4	
Trading	10.7	32.1	
Formal employment	12.5	15.1	
Artisan	25.0	22.6	
Reason for joining group (%)			χ^2 = 10.26*
Input support	36.7	36.7	
Social network	3.3	0.0	
Reciprocal labour	6.7	1.7	
Access to credit	21.7	43.3	
Learning	31.7	18.3	
Cooperation in FBO (%)			χ^2 = 7.40*
Weak	21.7	45.0	
Strong	78.3	55.0	
Reciprocity in FBO (%)			χ^2 = 51.87*
Low	25.0	84.7	
High	75.0	15.3	
Age (years)	50.2	47.8	t = 1.02
Years of formal education	9.5	9.0	t = 0.84
Household size	5.3	7.5	t = 4.50*
Number of cocoa farms	2.3	2.0	t = 1.67
Cocoa farm size (acres)	4.6	3.8	t = 1.42
Output (bags)	12.0	10	t = 0.69
Proportion of cocoa in total income	71.0	72.1	t = 0.34

Significant differences ($p < 0.05$) between categories or rows.

The results presented in Table 4.4 do not account for the observed differences in demographic and FBO characteristics mentioned above. This was remedied by running regressions with Difference-in-Difference methods while controlling for demographic and group characteristics for the following dependent variables: changes in pre-harvest knowledge, post-harvest knowledge, total knowledge, and quality (Table 4.7). Regarding changes in knowledge, the coefficient of participation in FPR is significant and positive in all three cases, indicating that farmers learn significantly more through FPR than through CE. Specifically, learning through FPR increases the scores on pre-harvest, post-harvest, and total knowledge scores with 3, 8, and 11 percent, respectively.

Knowledge scores also were significantly influenced by the benefits farmers expected from their FBOs. Farmers joined FBOs to have access to physical inputs, social support, reciprocal labour, or credit facilities. These factors are coded in the model as dummy variables with access to inputs as the reference variable. Farmers who had joined FBOs in order to have access to credit gained 13% more pre-harvest knowledge than farmers who had joined for the purposes of receiving physical inputs. Similarly, the farmers who joined their FBOs to have access to credit recorded 6% more total knowledge compared to farmer who joined for input support.

Table 4.6 Percentage of respondents who scored correct answers for knowledge questions

Activities that can influence cocoa bean quality	FPR farmers (N=60)				CE farmers (N=60)			
	Bef-ore	Aft-er	Chan-ge	Chi sq. (χ^2)	Bef-ore	Aft-er	Chan-ge	Chi sq. (χ^2)
Pre-harvest								
Fertile soils	72	88	17	5.2*	75	73	-2	0.0
Farm sanitation	68	83	15	3.7*	85	87	2	0.9
Healthy pods	68	98	30	10.2*	53	65	12	5.2*
Insect pod damage	40	13	-27	4.0*	50	55	5	6.9*
Chemical use	58	100	42	28.3*	52	60	8	2.2
Diseases	43	78	35	13.3*	52	70	18	0.1
Chemical spraying	30	60	30	64.6*	35	57	22	7.5*
Post-harvest								
Frequency of harvest	82	92	10	0.2	73	73	0	0.2
Days of pod storage	63	80	17	0.1	73	78	5	3.7*
Pod breaking	45	58	13	15.7*	70	73	3	1.1
Fermentation process	67	82	15	3.5*	63	72	8	1.0
Days of fermentation	72	78	7	0.7	75	83	8	1.1

* $p < 0.05$

4.3.5 *Impact of FPR on farmers' cocoa yields and bean quality scores*

FPR farmers reported a 25% yield increase of their own farms (from 189 kg ha^{-1} to 238 kg ha^{-1}) during the study period significantly more than the 8% reported by CE farmers, (229 kg ha^{-1} and 247 $kgha^{-1}$, respectively (Table 4.2B) FPR farmers improved their bean quality scores from 70 to 75%, and CE farmers from 69 to 71%, so 3% significant improvement can be attributed to taking part in FPR (Table 4.2B). Changes in quality scores on their own plots attributed to participation in FPR however did not reach the 17% achieved on the experimental FPR plots (Table 4.2A & 4.2B). Finally, we regressed the improvement in bean quality scores achieved on one's own farm on whether a farmer participated in FPR, controlling for demographic and group characteristic differences (Table 4.7). The results confirm the significant positive effect of taking part in FPR on farmer bean quality.

Table 4.7 Parameter estimates of change in knowledge and change in quality regressions

	Knowledge change models[(iii)]			Quality change model
Variable	Pre-harvest	Post-harvest	Total	
Constant time effect	7.8 (1.179)	6.4 (0.948)	7.2 (1.391)	3.7 (2.355)
FPR participation	3.4 (3.394)*	8.2 (2.042)*	11.2 (3.634)*	2.8 (3.024)*
Household size	-0.4 (-.627)	-0.4 (-0.701)	-0.4 (-0.847)	0.1 (0.160)*
Other economic activity [(i)]				
Farming	-1.0 (-0.214)	1.3 (0.275)	-0.04 (-0.010)	-0.9 (-0.882)
Processing	8.0 (1.310)	3.5 (0.572)	6.1 (1.286)	-0.1 (-0.060)
Trading	-4.0 (-0.825)	7.4 (1.518)	0.80 (0.206)	-2.0 (-1.783)
Artisan	0.8 (0.167)	5.5 (1.166)	2.8 (0.755)	-0.8 (-0.727)
Reason for joining FBO [(ii)]				
Social support	13.1 (1.118)	-5.2 (-0.441)	5.4 (0.595)	-2.1 (-0.758)
Labour support	1.0 (0.126)	-6.4 (-0.823)	-2.1 (-0.351)	1.6 (0.903)
Credit support	11.5 (3.097)*	-1.8 (-0.481)	6.0 (2.049)*	-1.2 (-1.400)
Learning	4.5 (1.115)	-7.6 (-1.839)	-0.5 (-1.63)	-0.6 (-0.607)
Cooperation in FBO	1.4 (0.433)	0.2 (0.045)	1.0 (0.347)	-0.3 (-0.356)
Reciprocity in FBO	-6.6 (-1.622)	1.2 (0.300)	-3.3 (-1.047)	-0.2 (-0.256)
Regression diagnostics	$R^2 = 0.246$	$R^2 = 0.122$	$R^2 = 0.224$	$R^2 = 0.198$;
	F = 2.722*	F = 1.163	F = 2.405*	F = 2.058*

Notes: (i) Reference variable is "farming", (ii) Reference variable is " input support" , (iii) t-statistic in parenthesis

* $p < 0.05$

4.4 Discussion

This study reveals that using GAPs can enhance the cocoa bean quality 17% more than current practices. Hence, as Quarmine et. al., (2012) and Adzaho et al, (2010) pointed out, there is room for farmers to improve the quality of their produce, in particular by reducing the proportion of beans with purple cotyledons. In recent years, international demands have led to strict requirements about the proportion of purple beans that can be tolerated (Kolavalli, et al. 2012). These standards can be met if farmers will protect their cocoa pods and beans from pests and diseases; harvest only ripe pods; break the pods with care; discard all diseased beans; ferment well; and polish and dry beans to appropriate moisture content (Masters, 2000).

Earlier studies on cocoa bean quality were usually limited to a specific number of post-harvest practices (Anim-Kwapong et al., 2006; Anim-Kwapong et al., 2007; Dongo and Sogwa, 2009; Gilmour, 2009). This study has extended these studies by assessing the effect of an entire set of recommended quality-enhancing practices. We have further analysed the profitability of producing quality cocoa beans with GAPs, and compared this with the profitability of existing farmer practices. At a cocoa price of US$ 1.86 per kilogramme, profits per hectare were with GAPs about 8 percent higher than with FPs, just because GAPs yielded higher volumes of cocoa. If cocoa prices at the farm gate would be differentiated by quality, the relative profitability of using GAPs would even be higher.

Having evaluated together with farmers the effectiveness of GAPs, we compared farmers who took part in the participatory research with farmers who learned GAPs through conventional linear extension methods, and found that knowledge of the former group was improved more. FPR participants increased their knowledge on all pre-harvest farm activities that could enhance cocoa bean quality. They also increased knowledge scores on post-harvest activities, such as pod handling and fermentation of beans. We can safely say that their advances in learning were induced by the active participation of farmers in the frequent collective activities regarding treatment, observation, analysis, and discussion of GAPs with other stakeholders. Our findings are in line with much of the theoretical and empirical literature that suggests that participatory methods of innovation development result in significant improvement of farmer knowledge (Biggs, 2007; De Jagger et al., 2004; Ton, 2005). However, farmers involved in conventional extension also improved their knowledge over the study period. Regarding pre-harvest activities, they learned more about pest and disease control, and regarding post- harvest activities, they improved their knowledge of pod storage. Besides extension officers, these farmers could have obtained cocoa production information from neighbour farmers, mobile-telephone

messages, newspaper publications, and television and radio services (Hainmueller, et al, 2011).

Farmers' objective for joining their FBOs is an essential determinant of improvement in knowledge scores. Farmers who joined FBOs to have access to credit recorded higher scores on pre-harvest knowledge and on total knowledge. This observation is similar to empirical findings by Asante et. al. (2011) among small-scale farmers in the Eastern Region of Ghana where this study was conducted. Farmers who joined FBOs with the aim of acquiring access to credit were particularly interested in raising their income, and therefore were motivated to pay more attention to group activities that could create opportunities in this area.

A major expectation of this study was that, in line with the literature, farmers with improved knowledge will try out their new acquired information on their farms and hence improve the quality of their produce. Two results regarding this hypothesis were observed in this study. First, already, 68% of the cocoa beans from all farmers were of good quality. This level of quality meets the average minimum market requirements even though it falls short of current highest grade standards set by COCOBOD (Kolavalli, *et al*. 2012). There are historical and social factors which can explain this finding (Leiter and Harding, 2004). For instance, Ton et al (2008) explain that at the developmental stage of Ghana's cocoa sector, farmer cooperatives were used in the past as a mechanism of cocoa bean quality control. Farmers supplied their cocoa through cooperatives which had internal rules for ensuring their members supplied good quality cocoa beans before onward sales to COCOBOD. With the collapse of cocoa cooperatives, COCOBOD instituted a policy of on-farm grading and paying for different grading of quality beans accompanied by a system of rewards and strict punishments (Amoah, 1998). Even though these institutional mechanisms have collapsed, the perception of what constitutes acceptable quality cocoa beans may have been passed on to latter generations of farmers and have thus become the norm.

Second, although FPR farmers significantly increased their knowledge of GAPs, their try-outs of these technologies on their own fields only resulted in a moderate improvement in cocoa bean quality. This was lower than what we could expect from the literature (De Jagger, 2004; Röling, 2009), and from the strong increase in quality produced on the experimental FRP plots. This suggests that full adoption of GAPs did not take place over the study period. Farmers involved in the FPR may have selected only few GAPs activities to try out on their own farms. This behaviour pattern is explained by the theory of technology adoption which suggests that farmers try recommendations for themselves under their own conditions and pace as a basis of their adoption decision (Rogers, 1995; Leeuwis, 2004).

Furthermore, even though the interactive FPR may have exposed farmers to GAPs, they were not sure about the expected yields and potential profitability during the one year experimentation period. Through joint treatment of GAPs plots and analyses of outcomes it became clear to farmers that GAPs involves higher costs while the profitability could be uncertain and dependent on the behaviour of neighbouring farmers. In Ghana, cocoa is cropped by many smallholders whose farms are next to each other. Suppose a GAPs-adopting farmer is surrounded by farmers who do not invest in maintaining their farms. Then his effort may not yield desired results because of a transfer of pests and diseases from neighbouring farms. An example is the black pod disease, which spreads from infected pods left that left unattended to on the tree or on the ground in the farms. GAPs require that such pods should be discarded off the farm in order to manage the black pod disease. A GAPs-adopting farmer may have his farm damaged by black pods because his neighbour does not discard off diseased pods appropriately. Hence, it is likely that farmers were trying out specific GAPs practices which were only appropriate to their farm bio-physical conditions. Farmers were also selecting practices which minimized costs and had potential of improving their yields.

Another reason why farmers were selective about GAPs is the nature of the market facing them. In Ghana's internal cocoa market, the quality of beans are often untested or imperfectly tested prior to purchase. All cocoa sells for the same price. This characteristic of the internal cocoa market allows farmers to hold information about their bean quality from buyers at the point of sale. Hence, without changing much of their post-harvest practices, farmers can still sell their cocoa. A cost-minimizing farmer will therefore adopt more pre-harvest GAPs as they increase output, and will not be motivated to enhance cocoa bean quality, even if newer standards are communicated to them (Fold, 2001).

4.5 Conclusions and recommendations

This study demonstrates that farmers' knowledge about innovations is more improved if farmers are involved in the development and experimentation of these innovations than when they are just passive end-users. Hence, the present extension system in Ghana will have higher impact if policy and research and development practice build in more participatory approaches. Another conclusion of policy interest from the findings of this study is that farmers are likely to take keener interest and get more involved in extension activities than they are presently, if they are linked to reliable sources of credit.

Improved knowledge however may not be sufficient to motivate famers to adopt practices which will enhance quality beyond minimum market requirements. A sufficient condition for adoption of innovation, in spite of improved knowledge, will

therefore be the existence of price or institutional mechanisms which motivate farmers to supply cocoa beans with higher quality standards. Current government policies that are targeted at motivating farmers to produce quality cocoa are often too broad to elicit the desired outcome. These policies tend to take advantage of social conditions such as reciprocity which oblige farmers to improve quality because of support services like scholarships, mass-farm spraying and production-based bonuses which government provides them. The problem with such an approach is that these support services are not linked to production of quality cocoa beans, although policy makers expect it as an outcome. Also, so long as all farmers cannot access these services, they do not provide much incentive for enhancing cocoa bean quality.

Policy effort, therefore, needs to be directed at market institutions, which affects all farmers directly. In particular, institutions which ensure that buyers screen good from average quality beans at farmgate are recommended. An example of such an institution is organization of cocoa trading through certified FBOs which can apply their internal rules to regulate the adoption of quality-enhancing GAPs. Another example is a policy of on-farm grading with accompanied enforceable punishment and reward systems like price differentiation. While the policy of on-farm grading with price differentiation has been tried by Ghana in the 1960s, there is no systematic study that explains why the policy was stopped or that investigates its appropriateness for the current cocoa sector.

Chapter 5

Incentives to produce quality cocoa under certification in Ghana

5.1 Introduction

This chapter investigates how certification programmes in the cocoa sector of Ghana attempt to solve the problems of asymmetric information that hamper the production of high-quality beans Ghana. In agricultural markets buyers, who purchase produce directly from farmers before onward sale, are often unable to determine the quality features of the produce before or even after purchase. This inability leads to a situation of asymmetric information where farmers know more about product quality than buyers. As a consequence, farmers have little or no incentive to spend extra costs and efforts to improve the quality of their produce. The cost of upgrading produce quality before it reaches the final consumer therefore falls to buyers, because they have no means of knowing which farmer produces what quality grade. Information economics theories suggest that buyers may design incentive mechanisms that motivate farmers to enhance the quality of their produce (Akerlof, 1970; Maskin, 2008; Mirrlees, 1997; Stiglitz, 1987)

Examples of potential incentive mechanisms in agricultural markets include supervision of farmers during the production period, quality measurement before purchase, and the use of price premiums (Hueth at al., 1999; Wolf et al., 2001). However, these mechanisms are often too costly for first buyers to implement, given their small marketing margins (Jacoby and Mansuri, 2007; Feder, 1985). A number of authors therefore propose that third-party certification may provide a more efficient and more effective way to tackle the information problems in agricultural markets (Hertel et al., 2009; Wimmer and Chezum, 2003). Certification programmes are able to sell labelled produce in high-value markets, so they at least tend to have the financial capacity to absorb the operation costs of specific incentive mechanisms. Although a number of certification programmes exist in Ghana's cocoa sector, very little research has been done on how they manage the problem of information asymmetry and which incentive mechanisms they employ to maintain or increase the quality of cocoa.

The literature on certification in agriculture mainly deals with the impact of certification on the adoption of recommended farming practices that improve yields or safeguard the environment and its welfare implications for smallholders (Barham and Weber, 2012; Beuchelt and Zeller, 2011; Bolwig et al., 2009; Buehler and Schuett,

2012; Dorr and Grote, 2009; Jena et al., 2012; Kleemann and Abdulai, 2012). For example, Dorr and Grote (2009) show that certification in the Brazilian fruit sector led to higher farm productivity and production. With respect to the Ghanaian cocoa sector, Afari-Sefa et al. (2010) and Gockowski et al. (2013) conclude that certification standards, through their positive effects on production, present a more profitable option for smallholders than existing production systems. Kleeman and Abdulai (2012) find that smallholders in certification were more likely to adopt environment-friendly farming practices. How certification can generate such positive outcomes is debated. Some studies suggest that paying price premiums in certification schemes is the most effective incentive mechanism to influence farmer behaviour (Lohr and Park, 1992; Valkila, 2009). Other studies point to non-price incentive mechanisms, such as farmer training, supervision of production, and social control through farmer organizations (Dorr and Grote, 2009).

The literature on certification often focuses on yields and production methods, and largely ignores the quality dimension of the produce. Specifically, it fails to deal with one critical issue: which incentive mechanisms certification schemes employ to elicit the high level of effort required of farmers to produce crops of sufficient quality. In particular, considering that in the market higher quality is not compensated by higher price due to the information problems mentioned above. In this chapter, we address this issue by examining a particular certification programme in the Ghanaian cocoa sector. This study will identify the main incentive mechanisms used by this programme and assess their effectiveness with respect to the level of effort and commitment by farmers to invest in the practices and the resulting yield and quality of cocoa, by comparing the outcomes with those of the standard practices in the mainstream market.

Which certification programmes exist in Ghana's cocoa supply chain? The study focuses on the Oyoko cocoa district of the Eastern Region of Ghana, where a certain certification programme operates under the umbrella of a producer organization called Cocoa Organic Farmers Association (COFA). COFA works alongside the main stream market, but has different trading practices and incentive mechanisms. These incentive mechanisms comprise both price and non-price structures. Farmers have the liberty to sell their cocoa independently in the mainstream market to licensed buying companies (LBCs) or join COFA and abide by the rules of certification.

The study proceeded by doing three exercises. First, since all farmers in the sample can choose the channel through which to sell their cocoa, we identified the determinants of the choice between being an independent farmer and being a certified farmer. The second exercise is to identify the most important price and non-price incentive mechanisms employed by COFA and those under the mainstream cocoa

market regime, and to rate the influence of each mechanism on the practices of the two types of farmers. It was expected that differences in trading practices and incentive mechanisms will influence the performance of COFA members and independent farmers in terms of input (effort) and output (quantity and quality of cocoa beans). Therefore, the final exercise is to compare COFA-farmers with independent farmers on the basis of the level of labour input into production practices, the yields they achieve, and the realized average bean qualities.

Section 5.2 begins with a review of the different types of certification programmes existing in Ghana's cocoa supply chain. Section 5.3 sketches the theoretical framework of the study, which among other things helps us to study why some farmers choose to be a member of a certification programme while other farmers want to stay independent. Section 5.4 discusses the empirical strategy and the collected data. Primary data were obtained from a survey of 161 COFA members and 161 independent farmers using a pre-tested semi-structured questionnaire. Section 5.5 presents the results. Section 5.6 rounds of with a discussion and conclusions, including some policy recommendations.

5.2 Certification in Ghana's cocoa market

Ghana's cocoa supply chain is relatively short. Cocoa beans move from farmers to licensed buying companies (LBCs) to the Cocoa Marketing Company (CMC) - the government-owned exporter. Whereas all private-run certification programmes exist at farmgate, only one state-run certification system exists up the supply chain, through which eventually all beans must pass.

5.2.1 Farmgate-level certification

From the perspective of smallholder farmers, two types of private cocoa certification programmes exist in Ghana. The first type focuses on the process by which the crop is grown. Organic certification and other systems that impose standards of sustainable cocoa production can be placed in this category. The second type focuses on improving the trading position of farmers through different methods of distributing premium prices. An example is fair-trade certification, which pays a collective premium to farmer-based organizations (FBOs) or their communities. The fair- trade approach can be distinguished from other certification schemes that pay price premiums to individual farmers.

In spite of these differences, the operation of private certification programmes at farmgate is similar. Production standards are determined by private labelling organizations. Standards are developed in response to the demands of cocoa-product manufacturers and final consumers of chocolate products. Some of the standards include rules regarding chemical use, good cultural practice, quality standards, and

whether or not children are allowed in the production process (Ponte and Gibbon, 2005). When farmers are able to meet certification standards, they receive a premium price. For ease of coordination, most labelling organizations work with FBOs. It is the responsibility of the FBOs to develop incentive mechanisms to ensure that their members meet certification standards. Usually, non-governmental organizations (NGOs) partner with FBOs and build their capacity to develop and enforce incentive mechanisms.

In this chapter, we study the incentive mechanisms employed by a certified FBO in the Oyoko Cocoa District, called COFA. This FBO subscribes to the standards of Control Union organic cocoa certification. Control Union is a multinational company which develops and executes certification programmes for various agricultural commodities. COFA is organized and trained by an NGO called Agro-Eco to implement a number of incentive mechanisms. First, COFA provides regular training for services on certification standards to their member farmers. Second, COFA employs farm inspectors who monitor production activities. After each farm inspection, detailed records on farmers and their production activities are kept. Third, COFA regulates input use by its members by procuring and distributing only approved organic chemicals to their members. Finally, all COFA members supply their cocoa through the organization. The quality of their supply is tested before the produce is accepted. Testing follows the standard cocoa industry cut test (Schwan, 1998).[1] This cut test is not perfect, however, because only 300 beans out of an average of 55,000 per bag are sampled for testing. So, the threat of moral hazard persists, and COFA members still have an incentive to free ride and supply lower quality cocoa. COFA thus implements a traceability mechanism that follows the cocoa beans of individual farmers until they are handed over to the final processor. In this traceability system, each member's plot of land is coded and assigned a number of coded bags in which its beans are stored in the COFA warehouse. Hence, any cocoa beans that pass COFA's test but are rejected up the supply chain can be traced back to the individual producer.

COFA applies a number of punishment systems with these mechanisms. Punishment ranges from simple reproach through rejection of poor quality cocoa beans to loss of group membership. When beans are rejected or membership is revoked, COFA members have to sell their cocoa as independent farmers to LBCs, where they are paid the national annual price per unit of cocoa determined by the Cocoa Board (COCOBOD).[2] When cocoa beans are accepted by COFA, farmers receive a price that consists of the COCOBOD price plus a 10% premium. Finally, as a collective, COFA

[1] The cut test involves cutting a sample of cocoa beans (normally 300) lengthwise through the middle in order to expose the maximum cut surface of the cotyledons. Both halves are examined in full daylight to make a judgment on whether the beans are well dried, fermented, and without any defect.

members apply social control on each other to ensure that the group does not lose its reputation as a producer of certified organic cocoa beans.

5.2.2 Certification up the supply chain

Independent farmers are not certified at farmgate. The national policy on quality control at farmgate is that LBCs should supply cocoa beans to CMC that meet a certain minimum quality standard (MQS). Unlike COFA, LBCs do not organize special training sessions for farmers, nor do they monitor farmer activities or keep record of farmer practices. To satisfy the quality requirements up the supply chain, they conduct an elementary observation of a farmers' supply of beans. This test is less rigorous than the standard cut test, because it has no uniform sampling and testing procedure. Moreover, unlike COFA, LBCs have no further incentive mechanism that can indirectly perfect their quality test. After purchase from farmers, LBCs bulk all cocoa for further upgrading before onward supply to CMC. Thus the threat of moral hazard on the part of farmers is not reduced, since after bulking LBCs are unable to identify which farmer supplied what consignment of cocoa.

Up the chain, Ghana's cocoa regulations state that:

> *"…no person shall market or export any cocoa unless: (1) it is cocoa which is the property of COCOBOD; or it is cocoa which has been graded and sealed, the export of which has been authorized in writing by the certifying authority of the COCOBOD…"*[3]

This implies LBCs, COFA, and all other farmer-level certification programmes are required to be part of the state-run certification system. In this certification system, the Quality Control Company Limited (QCCL), which is a subsidiary of COCOBOD, sets and reviews quality standards annually.[4] When buyers (LBCs, COFA) are ready to forward cocoa to CMC for export, they must first store all bags of cocoa in their district warehouse and then write an application request to QCCL to certify their bags. QCCL officials inspect the premises of the district warehouse to ensure it meets sanitation standards for storing cocoa beans. The standard cut test is applied to assess the quality grade of each bag of cocoa. Bags are marked with the seal of COCOBOD, the quality grade, the district, and the LBC or FBO from which they are purchased. Neither the village where the cocoa was bought nor the farmer who produced it is coded on the bag. Any cost incurred up the chain associated with upgrading is borne by the LBC or FBO from which the cocoa was purchased.

[3] Ghana Cocoa Board Law, 1984, (PNDC. L.81) and the Export of Cocoa Regulations 2004. http://www.cocobod.gh/images/export_of_Cocoa_Regulations.pdf

[4] See Chapter 3 of this thesis for a full definition of quality standards

Finally, once cocoa is certified by QCCL it is ready for export. Both cocoa from independent farmers and cocoa from COFA farmers sell at a premium on the world market, although export prices may differ. Apart from financing the producer price, the export earnings realized through the mainstream market are used to cover a broad range of costs: government taxes; value-chain-upgrading costs (such as road construction and maintenance); quality control; LBC margins; the head office, subsidiaries and divisions of COCOBOD ; and costs related to certain social services in the village (Kolavalli et al., 2012). The allocation of the export earnings realized through the certification market is much more concentrated. Most earnings are used to finance labelling organizations, incentive mechanisms, and the 10% premium.

5.3 Theoretical framework

5.3.1 Effort and production of quality cocoa beans

The amount of effort and commitment farmers apply to farm activities has been demonstrated to influence output significantly (Brada and Méndez, 2009). Producing cocoa beans of sufficient quality requires that farmers spend time and energy on a specific number of pre-harvest and post-harvest practices. Pre-harvest activities include soil fertility management, pest control, disease management, pruning and removal of parasitic plans, and general farm maintenance. These activities mainly determine the final volume of cocoa, but some pre-harvest activities like handling and control of pests and diseases also influence the final quality of cocoa beans. Post-harvest activities include timely harvesting, pod storage, pod breaking, bean fermentation, and drying and polishing. These tasks are the main determinants of the final quality of cocoa beans.[5]

It follows that, given farm sizes and capital inputs, the quantity and quality of cocoa beans increase with effort levels. In particular, post-harvest practices make high demands on producers' labour the quality of cocoa beans is elastic with respect to effort levels (Anim-Kwapong et al., 2007).

5.3.2 Mechanism design theory

Mechanism design theory can provide insights on how to provide incentives to farmers to increase the effort they apply to their production (Maskin, 2008; Mirrlees, 1997; Myerson, 2008; Hurwicz, 1994). Neoclassical economics assumes that all parties in a market have full information about the characteristics of the traded products or factors, and that the motivations of buyers and sellers are perfectly aligned. In practice, this assumption does not always hold. Cocoa buyers in Ghana have difficulties in

[5] During pod breaking, farmers must first avoid damaging the cocoa beans with the instrument of pod breaking. Second, they must sort and discard all disease/insect damaged beans.

observing the quality of cocoa beans, and are not sure of the motivation of farmers to provide the level of effort needed for sufficient quality. When this market failure favours farmers, they are likely to reduce the level of effort they apply to their production activities, negatively affecting the quality of their produce.

Mechanism design theory proposes that the party that is most affected by the market imperfection (in this case buyers) can offer a menu of options to the other party. The purpose of the menu is to attract farmers with different bean qualities to sell their produce under different arrangements. Following the discussion in Section 5.2, we observe that a menu of options to trade their cocoa beans have evolved in Ghana; the mainstream and certification markets. Following Paterson and Boisvert (2004), farmers are expected to select among the appropriate market arrangement on the menu which best suit their production practices and produce quality. In this chapter we the specific mechanisms employed under certification and the mainstream market are compared. Then, the impact of these mechanisms on farmers' motivation to supply quality cocoa beans are estimated.

5.3.3 Determinants of market choice

To analyse the choice of farmers to which market arrangement to supply their produce – the mainstream market or the certified market – we use the standard utility maximization framework. Suppose the reduced-form utility of farmer *i* (capturing both preferences and constraints) depends positively on the income he receives from selling cocoa (r) and negatively on the effort (e) he has to exert to produce cocoa according to the function:

$$U^i(r,e) \text{ with } \frac{\partial U^i}{\partial r} > 0 \text{ and } \frac{\partial U^i}{\partial e} < 0.$$

Let a farmer who exerts effort level e produce a quality of cocoa beans that is rewarded by $r(e)$. Suppose this function r is strictly increasing, so that higher effort results in higher income. The choice problem of farmer i is to choose an effort level that maximizes $U^i(r(e),e)$. The first-order condition of maximization implies

$$-\frac{\partial U^i/\partial e}{\partial U^i/\partial r} = \frac{\partial r}{\partial e}. \quad (1)$$

Hence, the optimal level of effort is such that the ratio of the marginal utility of reducing effort and the marginal utility of income equals the marginal income of effort. This ratio is the marginal rate of substitution between effort reduction (or leisure) and income, and measures how much income farmer *i* is willing to forego for one unit less effort.

Now suppose the certification market pays a higher price for cocoa than the mainstream market but implicitly also requires more production effort from the farmer. This simple model suggests that farmers then compare $U^i(r(e_L), e_L)$ with $U^i(r(e_H), e_H)$, where e_L and e_H are low and high effort levels. Farmers with a high need for income, and so a high marginal utility for income, will choose to supply to the certification market. Farmers with a strong desire to save effort, on the other hand, will go for the mainstream market.

5.4 Data and empirical strategy

5.4.1 Data

Data for this study were taken from both secondary and primary sources. Secondary data were obtained from files and publications of LBCs, COFA, and COCOBOD. Primary data were obtained from a survey of 161 COFA members and 161 independent farmers using a pre-tested semi-structured questionnaire. To arrive at this sample, information about the farmer population in the Oyoko District was first obtained from COFA executives, key informants, LBC staff, and COCOBOD staff using focus group discussions. Based on this information, a sampling frame was established. Eight communities -- Brong Densuso, Brong No. 1, Dome, Mangoase, Nankese, Nkurankan, Oyoko, Nyamekrom – were sampled for the study (Table 5.1).

Table 5.1 Sampling Frame

Community	Estimated Farmer Population	Sample size	
		COFA	Independent
Brong Densuso	361	58	58
Brong No 1	83	13	13
Dome	56	10	10
Mangoase	241	13	13
Nankese	363	20	20
Nkurankan	317	17	17
Oyoko	279	15	15
Nyamekrom	300	15	15
Total	2000	161	161

From each of these communities we targeted at least 10% of the estimated farmer population for sampling. The questionnaire collected information on farmers' demographic characteristics, effort on farm practices, yield, cocoa bean quality and perceptions about incentive mechanisms of COFA and LBCs.

5.4.2 Empirical strategy

Determinants of choice of certification

The empirical strategy proceeded in three steps. The first involved the use of logistic regression to identify the determinants of the choice between supplying to the certification market or to the mainstream market. The binary logit model has been employed by previous studies to model farmer decision making in Ghana (Akudugu et al., 2012; Aneani et al., 2012). As suggested in Section 5.3, the decision to sell through certification or to sell independently will be determined by the reduced preferences of the farmer for income (more effort) and leisure (less effort). Although the parameters of these preferences are unobservable, we can define a latent variable, y*, that implicitly captures these preferences such that y^*= 1 if a farmer prefers the combination of high income and high effort, and y^*= 0 if a farmer prefers the combination of low income and low effort. Applying the results of our first empirical step (Section 5.2.1), y^* can then be written as

$$y^* = \begin{cases} 1, & if\ COFA \\ 0, & if\ independent \end{cases} \tag{2}$$

This latent variable, y*, can be related to a set of explanatory variables X as follows:

$$y^* = \text{Log}[P_i/(1 - P_i)] = f(X_{ij}) \tag{3}$$

where P_i is the probability that farmer i chooses to join the certification programme, and $(1 - P_i)$ otherwise. X_{ij} is a vector of j exogenous variables containing socio-economic and farm characteristics. Marginal effects (at the sample mean) were estimated to determine the effect of changes in an explanatory variable on the probability a farmer joins the certification programme.

The explanatory variables of equation (3) consist of socioeconomic and farm characteristics that are expected to influence this trade-off (Boahene et al., 1999; Donnellan and Hennessy, 2007; Langyintuo and Mungoma, 2008). (see Appendix for

definition of variables). Specifically, we expected older farmers, land owners, males, large-scale farmers, and those with off-farm income to be independent farmers, because their willingness to sacrifice income for effort reduction seems relatively high (a high marginal rate of substitution between effort reduction and income). Moreover, younger farmers, more-educated farmers, indigenes or non-migrants are probably more flexible and open to new opportunities, which also suggest that they are member of COFA.

Comparison of incentive mechanisms of CoFA, LBCs and COCOBOD

Our second step was to assess the influence of a number of incentive mechanisms employed by COFA, LBCs, and the COCOBOD on the motivation of farmers to enhance the production of quality cocoa beans. We asked farmers to rate the influence of each specific incentive mechanisms on their effort and commitment to apply quality-enhancing farm practices.[6] Descriptive statistics were then used to assess the degree of influence of incentive mechanisms.

Estimation of impact of certification

Having assessed farmers opinions about mechanisms of certification and the mainstream market, the third empirical step was to compare the performance of COFA members with that of independent farmers with respect to effort levels, yields and cocoa beans. A counterfactual approach was followed to estimate the average treatment effect on the treated (ATT) or the impact of certification on COFA members (Heckman et al, 1997). This approach was followed because of potential selection biases in our cross-sectional data. Farmers self-selected themselves into treatment (COFA) and control (Independent) groups. Hence a simple comparison of their performance does not give an indication of causality since it is not clear whether treatment groups have similar comparisons. Selection bias also arises due to unobserved confounders between treatment and comparison groups. One way to overcome the selection bias is the use of propensity score matching techniques (PSM) (Rosenbaum and Rubin, 1983). PSM is a non-experimental technique which consists of matching treated observations with untreated observations on the basis of observed characteristics unaffected by the treatment (in this case propensity scores). The average treatment effect is then calculated as the mean difference in outcomes across these two groups, i.e. treated and untreated.

The "average treatment effect on treated" (hereafter ATT) can be written as:

$$\Delta_{\mathrm{ATT}}^{\mathrm{PSM}} = \mathrm{E}[\mathrm{Y}(1)|\mathrm{C}=1, \mathrm{p}(\mathrm{X})] - \mathrm{E}[\mathrm{Y}(1)|\mathrm{C}=0, \mathrm{p}(\mathrm{X})\ ] \qquad (4)$$

[6]The question was asked: "Rate how the following policies/mechanisms of your regular LBC motivate you to apply recommended farming practices. [1] Low [2] Average [3] High"

where $Y(1)$ and $Y(0)$ are values of the outcome variables of interest between treated and control farmers. C = 1 and C = 0 refer to treated and control farmers respectively. $p(X)$ corresponds to the propensity score, i.e. the probability that conditional to a set of observable covariates X, a farmer joins CoFA or sells independently.

The PSM technique requires two conditions to be fulfilled. The first is the conditional independence assumption (CIA), which assumes that the researcher observes all variables that can influence both the treatment and the potential outcomes. The second assumption is the common support condition which implies that the propensity score distribution is not very different in the treatment and the control group (Brodaty et al., 2007). Having met these conditions, the PSM technique proceeds in three steps as follows:

(a) *Estimation propensity scores*: The binary logit model in equation (3) was used to calculate propensity scores. In order to satisfy the common support condition, only variables which are unaffected by participation in COFA activities or are fixed over time entered the logit model.

(b) *Choice of matching algorithm:* Two matching algorithms were assessed in terms of the extent to which they reduce the biasness of our estimations (Table 5.6). The first was the nearest neighbour matching (NN). The NN matching estimator consists of matching each treated observation with an untreated observation that is the closest in terms of propensity score. We considered the one-to-one matching (n = 1), the three nearest-neighbour matching (n = 3), and the five nearest-neighbour matching (n = 5). The second matching method was the radius matching (RM). The RM matching estimator imposes a threshold on the maximum propensity score range or radius within which to match treated and control farmers (callipers). Three callipers were considered here; a wide radius (r = 0.03), a medium radius (r = 0.03), and tight radius (r = 0.01). Each of these matching options was without replacement.

(c) *Quality checks:* In order to ensure the quality of matching estimator we inspected the standardized bias reduction by the various methods. Also, bootstrapped standard errors were estimated.

Definition of outcome variables

Two broad categories of effort scores are identified in this chapter: pre-harvest and post-harvest effort scores. For pre-harvest activities we assigned an effort score for each task of weeding, pruning, chupon removal, mistletoe removal, pest and disease

management.[7] The average of these scores represents the pre-harvest effort score. Similarly, the post-harvest effort score equals the average of the individual scores for appropriate harvesting, pod breaking, fermentation, and drying methods. The effort score of each task was calculated as follows. Each score, ranging between 0 and 100, was based on indices of at least three factors: (1) time spent on a specific farm practice; (2) the proportion of farm the specific activity was applied to; and (3) the degree to which the application of the specific farm practice conformed with recommendations of the Cocoa Research Institute of Ghana (CRIG). For example, CRIG recommends weeding of the whole farm at least 4 times a year. A farmer who did not weed at all scored a zero as weeding effort. A farmer who weeded 30% of his farm just once over the entire season was assigned a weeding effort score of (0.25x 0.3) x 100 = 7.5). Yields and cocoa bean qualities were measured in a straightforward way. Yields are indicated in kg per hectare. Cocoa bean quality is also captured by a score between 0 and 100. Following Schwan (2008), 100 cocoa beans are randomly sampled, cut into two halves and inspected for physical damage. The number of cocoa beans out of the 100 that had no physical defects is recorded as the quality score.

5.5 Results

5.5.1 Determinants of participation in certification programmes

All farmers in the sample can choose to which market they wish to supply their cocoa beans. In this section, we try to identify the determinants of the choice between supplying to the certification market or to the mainstream market using a binary logistic model. Results of the logistic model on the factors affecting the probability of participation in certification programmes (joining COFA) are presented in Table 5.2. Model-diagnostic tests show that the logistic equation is appropriate for the analyses. The Hosmer-Lemeshow test statistic (6.695; $p > 0.05$) indicates that the model fits the data well. Sensitivity and specificity test scores also show that the model has a 70% and 76% chance of correctly predicting the probability of participation and non-participation.

Farmers are more likely to participate in certification programmes if they are indigenes (born in the village), have more years of experience, have more formal education, are involved in share cropping contracts, and also trade non-farm goods (Table 5.2). Marginal effects estimations indicate that, holding other factors constant, being an indigene rather than a migrant increases the probability of participation by 18 percentage points. One more year of experience in cocoa farming increases the probability of participation by 2 percent. Compared with no education, primary

[7] A chupon is a newly growing stem that emerges at the base of the cocoa tree

education (6 years of formal schooling), increase the chance of joining certification by 25% and junior high school education (nine years of formal schooling) raises the probability of participation by 23 percent. Also, schooling beyond junior high school has a positive effect: senior high school education (12 years of formal education) or more increases this probability by 30 percent. Land use contracts are another important factor.

Share cropping is an important determinant of participation in certification programmes. Two share cropping contracts are identified in the study area. These are the abunu contract where a sharecropper receives half of the output and the abusa contract where a sharecropper receives a third of the output. As compared with complete ownership of the farm, having abusa farms increases the probability of participation by 40 percent. Owning a farm in addition to an abunu plot increases this probability by 50 percent. Similarly, farmers with both own and abusa farms have a 52 percent likelihood of participation, and for farmers with both abunu and abusa farms this is 36 percent.

Factors that reduce the likelihood of participating in certification programmes include age and dependence on cocoa. Marginal effects reported in Table 5.2 reveal that when a farmer is one year older, he or she has a lower probability of participation of 1 percent. Farmers with a one percent higher proportion of cocoa income in their total farm have a 1 percent lower probability of joining certification programmes. Additionally, indigenous farmers have an 18 percent more probability of joining certification compared to migrants.

To some extent these results can be explained by referring to the theoretical framework discussed in Section 5.3.3. Above we have shown that the certification market pays a higher price for cocoa than the mainstream market, but implicitly also demands more production effort from the farmer because certification imposes particular production and processing standards. The theoretical framework then suggests that farmers with a high need for income, and so a high marginal utility for income, will choose to join the certification programme. On the other hand, farmers with strong preferences or heavy constraints that put weight on saving effort will go for the mainstream market and sell their cocoa to local LBCs. This theoretical perspective is largely in line with our observation that farmers with socio-economic characteristics that indicate higher income status and potentially more critical health problems, such as farmers with sufficiently big farms to allow cocoa to be the major income source and who are of older age, are less likely to participate in certification programmes.

An important indicator of the need for more income (high marginal utility of income) is whether or not farmers are involved in sharecropping. Share cropping

means that a farmer must give up part of the output/income he produces (Quarmine et al., 2012).

Table 5.2 Results of regression of determinants of participation in certification programmes

DV = COFA Membership	Marginal effects	Robust standard errors
Age	-0.011	0.025*
Sex	-0.155	0.126
Marital status	0.171	0.104
Household size	-0.034	0.011*
Migration status	0.181	0.089*
Size cocoa farm	-0.033	0.033
Size other farm	-0.023	0.020
Dependence on cocoa	-0006	0.002*
Experience	0.198	0.004*
Education Level		
Primary	*0.250*	*0.103**
Junior high	*0.285*	*0.106**
Secondary and above	*0.300*	*0.110**
Land use contract		
Abunu	*0.251*	*0.085**
Abusa	*0.408*	*0.076**
Own_abunu	*0.492*	*0.042**
Own_abusa	*0.520*	*0.042**
Abunu_Abusa	*0.362*	*0.090**
Own_Abunu_Abusa	*0.466*	*0.055**
Other economic activity		
Processing	*-0.011*	*0.0913*
Trading	*0.160*	*0.125*
Office work	*-0.128*	*0.114*
Processing-trade-office	*-0.092*	*0.165*
Regression diagnostics		
Pseudo R-squared		0.239
Hosmer-Lemeshow test		6.695 p=0.515)
Sensitivity (%)		70.2
Specificity (%)		76.4
False Positive Rate (%)		25.2
False Negative Rate (%)		28.1

See appendix for definition of variables *= p<0.05

The more output/income he has to give up, the more likely it is that he will join certification programmes. This is evident in our results. Abusa farmers, who forego two-thirds of their crop, had the highest likelihood of joining certification programmes. Farmers that for some reason are constrained in their capacity to apply extra effort to their pre-harvest and post-harvest activities, by lack of time or health conditions, are not likely to join the certification programme. This is another reason why younger farmers had a higher likelihood of joining certification programmes.

5.5.2 Incentive mechanisms

The obvious question which follows is what price and non-price incentive structures motivate farmers to exert the levels of effort we observed and so produce higher volumes of quality cocoa? We address this question by discussing the rankings farmers made of the influence of the various incentive mechanisms implemented within the mainstream cocoa market (by COCOBOD and LBCs) and the certification market (by COFA).

COCOBOD incentive mechanisms

The major incentive policies of COCOBOD relate to producer price, (free) mass-spraying of farms, credit services, extension services, and scholarship programmes for children of farmers. These policies extend to all cocoa farms in Ghana, thus including farmers who work under certification programmes. The overall expectation was that the extent to which these policies influence farmers depends on whether they are independent or members of COFA, because being organized under an FBO usually empowers farmers to better take advantage of existing policies and services. How COFA members and independent farmers rate these polices is presented in Table 5.3.

In general, the producer price of cocoa, which is determined by COCOBOD, has an average influence on both COFA and independent farmers. This suggests that if farmers have to increase their effort to enhance quality, merely increasing the producer price will not much encourage this. Significantly more COFA farmers than independent farmers reported low influence of producer prices on their effort levels. This is because COFA farmers receive a premium price in addition to the producer price. Some level of price competition can be observed among LBCs in the district. Some LBCs pay a token in addition to producer price (which is less than COFA premium) to attract higher volumes of cocoa beans. Table 5.3 shows that while 94% and 54% of COFA independent farmers respectively reported receiving extra prices for their cocoa beans. Most independent farmers were however not satisfied about this extra (token) price they received.

Another incentive policy of COCOBOD is the cocoa bonus. This is an extra amount of money paid to the farmer at the end of the season based on his or her yield.

Two categories of cocoa beans can be distinguished in Ghana during the two cropping seasons – main crop and light crop seasons. In the main crop season, cocoa beans are bigger in size while the light crop season yields smaller beans (Kolavalli et al., 2012).

Table 5.3 Farmers' rating of the influence of incentive policies of COCOBOD on the effort they apply to their farm activities

	Influence	COFA farmers (n=161)	Independent farmers (n=161)	Standard residuals (z-score)
Price policy	Low	27 (16.8)	7 (4.3)	2.4*
	Average	89 (55.3)	123 (76.4)	1.7
	High	45 (28.0)	31 (19.3)	1.1
Cocoa bonus	Low	37 (23.0)	18 (11.2)	1.8
	Average	22 (13.7)	9 (5.6)	1.7
	High	102 (63.4)	134 (83.2)	1.5
Credit facilities	Low	111 (68.9)	113 (82.6)	1.0
	Average	45 (28.0)	21 (13.0)	2.1*
	High	5 (3.1)	7 (4.3)	0.4
Mass-spraying	Low	41 (25.5)	7 (4.3)	3.5*
	Average	65 (40.4)	13 (8.1)	4.2*
	High	55 (34.2)	141 (87.6)	4.3*
Extension services	Low	112 (69.9)	118 (73.3)	0.3
	Average	22 (13.7)	12 (7.5)	1.2
	High	27 (16.8)	31 (19.3)	0.4
Scholarship	Low	7 (4.3)	19 (11.8)	1.7
	Average	138 (85.7)	135 (83.9)	0.1
	High	16 (9.9)	7 (4.3)	1.3

Figures represent frequency counts. Percentages are in parentheses. * = $p<0.05$ (-1.96 o +1.96)

COCOBOD uses the bonus mechanism to pass on additional revenues to producers for the supply of main crop cocoa, based on the consideration that the bigger beans are of better quality than the smaller ones. For every unit of main crop cocoa supplied to LBCs or COFA offices, farmers receive up to 6% of the producer price as

bonus every year. Table 5.3 shows that there is a high influence of the bonus on the effort levels both COFA and independent farmers. Hence, indirectly, the bonus appears to contribute to the production of higher volumes of big sized cocoa beans. COCOBOD has two incentive policies regarding input use: a fertilizer input credit facility, called High-tech, and a free mass-spraying policy. Even though some studies attribute the national increase in cocoa yields in Ghana since 2000 to this credit facility (Omane-Adjepong, 2012), our results show that in the Oyoko Cocoa District the Hi-Tech programme does not motivate farmers to exert more effort (Table 5.3). However, among those that reported a positive, though low level of influence, there are significantly more COFA farmers than independent farmers. Maybe this is because COFA is well organized and more capable of providing easy access to this facility.

Regarding the mass spraying policy of COCOBOD, the responses of COFA farmers and independent farmers are significantly different. Whereas a large majority (87%) of independent farmers thought mass-spraying policy highly influenced their effort, most COFA farmers reported a low or no influence at all. A key explanation is that because COFA farmers subscribe to organic cocoa certification, they have a different chemical use regime than independent farmers. Why does mass spraying influence the effort of independent farmers so much? A central condition for a farmer's field to be sprayed is that he has to undertake all the necessary farm practices (weeding, chupon removal, pruning, etc.). Hence, the production achieved under this regime is a combined effect of mass spraying and a number of agronomic practices.

With the reorganization of Ghana's extension services, we expected that extension workers would be a source of information and motivation for farmers to apply higher levels of effort in their production activities. Yet both independent and COFA farmers reported that COCOBOD's extension policy did not influence their effort. Maybe this is because extension services have just been revived, and impacts are still at the early stage. In Chapter 4, where current extension methods are evaluated, it is argue that more participatory methods have better impacts on farmers' effort than standard extension practices.

Regarding the scholarships provided by COCOBOD, the ratings of appreciation by the two groups of farmers are more or less similar. Both groups reported a low influence of the scholarship policy on their effort. One observation on these incentive mechanisms is that, COCOBOD policies may have contributed in attracting more farmers into cocoa production or for existing farmers to expand the area under production. However, they are not enough to address the problem of information asymmetry between buyers and farmers. CoFA incentive mechanisms on the other hand, tackle problems of quality directly. This is why CoFA incentive mechanisms are rated by farmers as being more influential than COCOBOD/LBC policies.

LBC incentive mechanisms

It is likely that both COFA and LBCs are aware of the limited incentives that are created by the policies of COCOBOD to stimulate the production of quality cocoa. Both have to cope with the upgrading costs that have to be incurred in order to meet the minimum quality standard (MQS). Below we turn to the incentive mechanisms employed by LBCs, which include the imposition of a simple quality test and the provision that farmers have the opportunity to recondition any rejected beans and supply them again for testing. Table 5.4 presents the ratings of the incentive mechanisms by, in this case, independent farmers

The influence of quality testing by LBCs on effort is low according to the majority of independent farmers (52%), though almost one third of the farmers reported a high influence. A reason might be the low predictive power of the test, resulting in high accepting rates, as discussed above. In fact, the quality tests differ a lot among LBCs as they fail to display clear standards to farmers. As a consequence, beans that are rejected by one LBC might be accepted by another. This probably also explains why independent farmers reported a low influence of the opportunity to resupply any rejected beans after reconditioning.

Table 5.4 Independent farmers' rating of the influence of incentive mechanisms of LBCs on the effort they apply to their farm activities

	Response	Frequency (percentage)
Quality test before purchase	Low	84 (52.2)
	Average	28 (17.4)
	High	49 (30.4)
Provision to resupply rejected beans	Low	139 (86.3)
	Average	13 (8.1)
	High	9 (5.6)

Sample size = 161. *= $p<0.05$ (-1.96 o +1.96)

COFA incentive mechanisms

The incentive mechanisms employed by COFA differ from those of LBCs in a number of ways. Recall that COFA pays a price at least 10% higher than the producer price and that a large majority of COFA farmers shows satisfaction with this price premium. Merely paying higher prices and using a stricter test do not completely solve the information problem, because the quality test used by COFA still has its imperfections. To reduce the scope for moral hazard, COFA therefore enforces a number of policies. Farmers who join COFA must make themselves available for

training and must allow their farms to be monitored on the standards of their certification programme. Further, recall that COFA implements a traceability mechanism that can trace back any cocoa beans that have passed the test but are rejected up the supply chain to the individual farmer.

Table 5.5 shows that COFA farmers did not regard monitoring as an important determinant of their effort level. As stated by some portion of the literature, monitoring of every farmer's activity over the entire production period is impractical (e.g., Jacoby and Mansuri, 2007). Hence, this imperfect monitoring may explain why it does not motivate farmers to supply more effort.

Table 5.5 COFA farmers' rating of the influence of incentive mechanisms on the effort they apply to their farm activities

	Response	Frequency (percentage)
Farm monitoring	Low	114 (70.8)
	Average	18 (11.2)
	High	29 (18.0)
Quality test before purchase	Low	9 (5.6)
	Average	2(1.2)
	High	150 (93.2)
Traceability	Low	39 (24.2)
	Average	51 (31.7)
	High	71 (44.1)
Training	Low	36 (22.3)
	Average	69 (42.9)
	High	56 (37.8)

Sample size = 161

The quality test employed by COFA turns out to be the most important driver of the effort of COFA farmers. About 93% of them rated the test to be of high influence on the effort levels they apply to their production activities (Table 5.5). This high impact underscores the effectiveness of the test used by COFA. As compared with the cursory inspection by LBCs, which only moderately motivated farmers, the cut test by COFA is a strong device that promotes almost all farmers in supplying high quality cocoa.

About 75% of the farmers reported an average or high influence of the traceability mechanism on their effort. This high response is understandable, as the traceability system implicitly perfects the whole testing process. By tracing back the poor cocoa to the farm where it was produced, the cost of upgrading is borne by the farmer. Finally, about 80% of the farmers reported an average or high influence of the training activities they were subjected to. One reason for this high score is that, as discussed by Marenya and Barrett (2007), training and the new information going with it may open the eyes of farmers to try new ways of production.

5.5.3 Impact of certification on effort, yield, and quality

To produce higher volumes of quality cocoa beans, farmers must exert higher levels of effort in their production and post-harvest activities. Table 5.6 compares the performance of COFA farmers and independent farmers with respect to effort, cocoa yields, and cocoa quality and reports the average treatment effect on the treated (ATT). Before discussing the effect of certification, the quality of the estimation techniques employed are discussed. First, the common support assumption is checked by inspecting the distribution of predicted propensity scores for both CoFA and independent farmers (Figure 5.1). The propensity scores for the whole sample ranged between 0.006 and 0.989 with a mean of 0.50 (SD = 0.26). The predicted propensity scores for COFA members fell between 0.048 and 0.989 with a mean of 0.636 (SD = 0.234). Independent farmers had an estimated propensity score ranging from 0.007 to 0.904 with a mean of 0.363 (SD = 0.215). This distribution of propensity scores implies enough area of common support. Observations with propensity scores higher than the maximum or smaller than the minimum in the control group are dropped in subsequent analyses (Dehejia and Wahba, 1999).

Next, the NN and RM matching methods were tried and the option which best reduced biases in the model was selected for the analyses. Table 5.6 presents results on the matching quality indicators of the different methods before and after matching. When the p-values of the likelihood ratio test (LR^2) are compared for NN matching, it is observed that, except for nearest neighbor 3, the hypothesis of joint significance among covariates could not be rejected. Hence neighbor 3 was the best option if the NN matching method was to be use. The p-values of the LR2 test for all the different calipers of the RM method showed that the hypothesis of joint significance among covariates was rejected. Therefore the choice of matching technique was made from NN (neighbor n = 3), RM (calliper r = 0.01), RM (calliper r= 0.03) and RM (calliper r =0.05) by comparing the percentage bias reduction. As can be observed from Table 5.6, RM (r = 0.03) and RM (r = 0.05) had a similar percentage bias reduction of about

143%. Hence, the RM (with calliper r = 0.03) estimator was selected as increasing the calliper did not reduce the percentage bias any further.

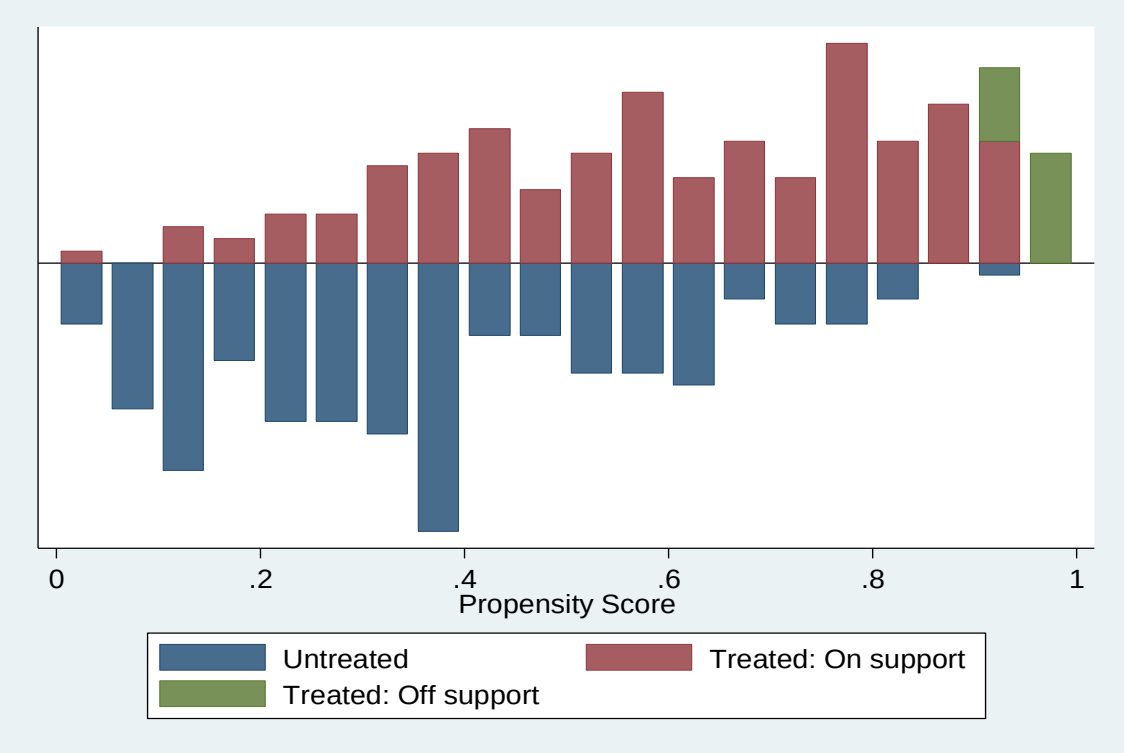

Figure 5.1 Distribution of propensity scores

Table 5.6 Matching quality indicators before and after matching

Matching estimator	Pseudo R^2		LR^2 of logit model		Mean Standardized bias		Total % bias reduction
	Before	After	Before	After	Before	After	
Nearest Neighbour (NN)							
Neighbour1	0.223	0.134	99.7(0.00)	56.52 (0.000)	17.31	15.20	156.97
Neighbour 2	0.223	1.101	99.7(0.00)	42.46 (0.030)	17.31	15.01	162.46
Neighbour 3	0.223	0.075	99.7(0.00)	31.69 (0.246)	17.31	10.06	90.27
Radius matching (RM)							
Caliper 0.01	0.223	0.045	99.7(0.00)	15.29 (0.965)	17.31	7.41	90.52
Caliper 0.03	0.223	0.060	99.7(0.00)	23.96 (0.684)	17.31	11.17	143.37
Caliper 0.05	0.223	0.082	99.7(0.00)	34.67 (0.180)	17.31	13.23	143.28

Notes: Estimators for the propensity scores were performed by using the PSMATCH2 programme developed by Leuven and Sianesi (2012) for the Stata 12.0 software.

Table 5.7 outlines the ATT effects of participation in certification programmes. With respect to pre-harvest activities, average mean effort scores of COFA farmers

were 17 percentage points significantly higher than those of independent farmers. Specifically, COFA members applied significantly more effort in weeding, pruning, and pest and disease management than independent farmers. Note that among COFA farmers relatively little effort was invested in insect and disease management compared with other pre-harvest activities. This can be explained by the generally low level of cocoa disease incidence in the Oyoko cocoa district. It is this observation of low pest incidence which prompted the COCOBOD to demarcate the district as an organic cocoa production zone.

Table 5.7 Effect of participation in certification on farmer's effort scores, yield and produce quality

	COFA farmers (n=161)	independent farmers (n=161)	ATT[a]	Robust Standard errors[b]	t-statistic
Pre-harvest effort					
Weeding	59.7	31.8	27.9	**3.537**	9.35*
Pruning	65.8	34.8	31.0	3.838	8.11*
Mistletoe removal	94.0	90.0	4.0	4.222	1.03
Chupon removal	94.8	89.7	5.1	5.153	1.26
Pest management	56.4	28.2	28.2	3.658	8.62*
Disease management	13.4	5.1	8.3	2.064	2.37*
Pre-harvest effort score	***64.0***	***46.6***	***17.4****	***4.175***	***8.79****
Post-harvest effort					
Pod breaking	63.1	51.3	11.8*	1.932	2.6
Harvesting	82.2	69.2	13.0*	2.788	4.2
Fermentation	83.1	65.8	17.3*	4.410	3.33
Drying and polishing	93.0	55.1	37.9*	5.466	6.26
Post-harvest effort score	***80.4***	***60.4***	***20.0****	***1.474***	***7.28***
Yield ($KgHa^{-1}$)	214.9	114.7	100.2	17.307	6
Quality scores	84.4	72.2	12.2	1.315	9.02

[a] ATT represents the average treatment effect on the treated farmers. Means were estimated based on propensity scores based on radius matching (caliper = 0.03).
*= $p<0.05$

Regarding post-harvest activities, the ATT estimates in Table 5.7 shows that COFA farmers exerted a significantly higher mean effort level than independent farmers in all practices (20 percentage points more). Pod breaking, fermentation, and drying and polishing activities are the main determinants of cocoa bean physical

quality. Pod breaking is critical because at this stage, farmers must take care to remove all diseased and defective beans from the harvest before fermentation, otherwise they compromise average quality. The chemical processes of fermentation do not just produce the unique chocolate flavour but also facilitate faster drying of cocoa beans (Anim-Kwapong et al., 2006). Drying and polishing results in a consistent product which is free of defective beans and foreign materials.

Holding other exogenous factors constant, pre-harvest efforts of farmers largely determine yields while post-harvest efforts determine the physical quality of cocoa beans (Anim-Kwapong et al., 2007). The study found that in the Oyoko cocoa district, CoFA members and independent farmers had a similar pattern of input use. The application of higher pre-harvest efforts by COFA members therefore explains why they recorded significantly more yield per hectare (52%) than did independent farmers. The high levels of effort applied to post-harvest practices by COFA members are reflected in the significantly better (12%) quality cocoa they produced as compared with independent farmers.

5.6 Discussion and concluding remarks

The results of this study indicate that certified producers apply a higher level of effort to enhance their cocoa bean quality than independent farmers. Holding other exogenous variables and input use constant, this higher level of effort explains why certified producers supply more volumes of quality cocoa than independent farmers. This finding is consistent with theoretical and empirical literature which suggests that institutions shape the actions of economic agents (North, 1990). As an institutional arrangement, the results indicate that certification provides high prospects for addressing the asymmetric information problem which threatens Ghana's consistent supply of premium quality cocoa beans to the international chocolate and confectionary market.

Certification programmes are able to elicit higher volumes of quality cocoa from farmers compared to the mainstream market because their incentive mechanisms more directly address information asymmetry. In particular, mechanisms of quality testing before purchase in combination with traceability have the most impact. Furthermore, these mechanisms work effectively because of the strict enforcement of punishment and rewards by the producer organization under which certification operates. In contrast, the mainstream market arrangement provides a number of general policies through COCOBOD. Our data confirms the position of Quarmine et al. (2012) that most of the policies from COCOBOD do not motivate farmers to increase their current effort levels because they are not designed to deal with problems

facing production of quality cocoa.[8] The closest mechanism of the mainstream market which influences farmers to produce quality cocoa is the cocoa bonus. However since the bonus does not reward different quality grades, it is unlikely that changing it will elicit additional effort from farmers. These results imply that extending the mechanisms of certification programmes to farmgate, especially traceability and the development of producer organizations, may address the threat posed by asymmetric information.

In line with the literature, the results of the study reveal that the need for higher income is a key determinant of farmers' choices, especially the decision to choose for certification or mainstream markets (Boahene et al, 1999). The need for income, together with the high influence of the cocoa bonus policy, leads us to conclude that when designing incentive mechanisms in the cocoa sector, buyers and policy makers need to focus attention on increasing producer incomes. This is where price-related incentive mechanisms become important. Future research is required to test the impact of alternative cocoa pricing mechanisms on farmers' incentive to supply higher volumes of quality cocoa beans. One limitation of this study is that our analysis is limited to a specific certification programme which pays a price premium directly to farmers. Further studies are required to analyse the impact mechanisms of other certification programmes like fair-trade, which pay a social premium to farmers' community. This study estimated farmers' efforts using their reported farm practices as proxies. Future studies may explore alternative measures of farmers' effort. Again, our approach to understand the specific mechanisms of certification programmes was to ask farmers to rate the importance of these mechanisms. A limitation of this approach is that it may not be incentive-compatible. This is because farmers may be reporting ratings of these mechanisms which do not reflect their real opinions. Future studies could estimate the influence of these mechanisms through alternative methods.

[8] See Chapter 3 of this thesis

Appendix 5.1 Descriptive Statistics of Variables

Variable	Measurement	Mean (n=322)	a-prior sign
Age	Years	53.21	-
Sex	1= Male, 0= Female	0.76	+
Marital status	1= Married 0 = Unmarried	0.74	+/-
Household size	Number of people in one household	6.43	+
Migration status	1 = Indigene, 0 = Migrant	0.22	+
Size cocoa farm	Size of cocoa farm in acres	5.32	-
Size other farm	Size of non-cocoa farm in acres	2.31	-
Dependence on cocoa	Percentage of cocoa in total household income	64.25	+
Experience	Number of years farming cocoa	22.24	+
Education Level			
Primary	1 = 6 years of formal education, 0 otherwise	0.23	+
Junior high	1 = 9 years of formal education, 0 otherwise	0.48	+
Secondary and above	1 = More than 9 years of formal education, 0	0.13	-
Land use contract			
Abunu	1 = Abunu land use contract only, 0 otherwise	0.12	+
Abusa	1 = Abusa land use contract only, 0 otherwise	0.24	-
Own_abunu	1 = Own farms and Abunu farms, 0 otherwise	0.06	+/-
Own_abusa	1 = Own farms and Abusa farms, 0 otherwise	0.05	+/-
Abunu_Abusa	1 = Abunu farms and Abusa farms, 0 otherwise	0.31	+/-
Own_Abunu_Abusa	1 = Own, Abunu and Abusa farms, 0 otherwise	0.01	+/-
Other economic activity			
Processing	1 = Farming and processing, 0 otherwise	0.14	-
Trading	1 = Farming and trading, 0 otherwise	0.24	-
Office work	1 = Farming and office work, 0 otherwise	0.16	-
Proc-trade-office	1 = Farm, processing and trade, 0 otherwise	0.12	-

Reference variable for education is “no formal education” (1 or 0 otherwise)

Reference variable for Land Use Contract is “Own farm only” (1 or 0 otherwise)

Reference variable for Other Economic activity is “Farming Only”(1 or 0 otherwise)

Chapter 6

Does price differentiation with self-selection motivate the production of quality cocoa by smallholders?

6.1 Introduction

The aim of this chapter is to examine alternative price mechanisms that can stimulate cocoa farmers to enhance the quality of their produce. A number of microeconomic studies have demonstrated a positive supply response to prices in Ghana's cocoa sector (Armah, 2009; Bateman, 1965; Quarmine *et al.*, 2012). These studies focus on how changes in producer price may increase the volume of cocoa beans and neglect how price movements affect cocoa bean quality. Drawing on these studies, producer price policy in Ghana has consequently involved paying a uniform producer price for all quality grades of cocoa beans so long as they meet a certain minimum standard (Fold, 2001; Leiter and Harding, 2004). Yet evidence presented in previous chapters of this thesis and in other studies suggests that the payment of a uniform price at farmgate does not solve emerging issues with cocoa bean quality which arise from problems of asymmetric information (Quarmine *et al.*, 2012). Under asymmetric information, buyers have no adequate information about the quality of cocoa beans individual farmers supply, and so cannot pay a price according to quality. As a result, farmers may not have enough incentive to further enhance the quality of their produce beyond minimum standards.

To address this information problem, economists have proposed a number of alternative mechanisms that can govern the interaction between farmers and buyers (Stiglitz, 1975; Guasch and Weiss, 1981; Salop and Salop, 1976; Padilla, 2003). One such mechanism is that buyers try to sort farmers' produce into different quality grades by using a screening device before purchase (Stiglitz, 1975). Related to agricultural markets, a much discussed screening device is certification or labelling (Stiglitz, 1975; Jahn et al., 2005). There is evidence that certification is an effective screening mechanism in Ghana's cocoa market (see Chapter 5). Certification solves the information problem in Ghana's cocoa market by providing price and non-price incentives for farmers to increase the production of cocoa of the highest quality (see Chapter 5). For example, through the mechanism of traceability, certification organizations are able to categorize producers of agricultural commodities according to the quality grades of their produce. Screening devices like certification however have their own problems. For instance, some studies show that certification sets demands in terms of time, capital, and training investments on participants, which not

only makes it an expensive solution but also leads to exclusion of less endowed smallholder farmers (Vuylsteke *et al.*, 2005).

Another way to tackle asymmetric information problems is the implementation of a self-selection device. Following Salop and Salop (1976), a self-selection device is a pricing scheme that causes the farmer to reveal truthful information to the buyer about the quality of his or her produce. One of the most popular self-selection devices, which has received much research attention and implicitly underlies many economic interactions, is the *test-cum-fee* pricing rule (Greenwood and McAfee, 1991; Guasch and Weiss, 1981; Haagsma, 1995; Ng, 2006; Padilla, 2003; Serti and Tomasi, 2008). The test-cum-fee device follows the "carrot and stick" format (Brousseau and Farès, 2000; Mirrlees, 1997) where a buyer offers a price higher than the market price so long as the supplied produce meets a certain high quality standard, but the seller must pay a fee to have his or her produce tested. If the produce meets the buyer's quality standard, the seller receives the high price (which more than compensates for the fee), otherwise he or she just gets the market price. As is already demonstrated by Guasch and Weiss (1981), test-cum-fee devices are a powerful instrument to discourage participation in transactions by unqualified parties. An appropriate combination of prices and fee lowers the test costs incurred by buyers and raises the average quality of the produce that passes the test, because through self-selection fewer sellers of low quality will apply (Guasch and Weiss, 1981; Salop and Salop, 1976).

Price differentiation with self-selection can benefit both farmers (at least in an ex ante sense) and LBCs (Licensed Buying Companies). The latter because the supply of potentially higher cocoa bean quality will lower the upgrading costs LBCs have to make after purchase. Yet, to the best of our knowledge, these hypotheses have not been empirically tested. We therefore conducted a quasi-experiment to examine the behavioural response of farmers to a specific test-cum-fee pricing rule. The experiment was held during two cocoa seasons, allowing farmers also to respond with their farming practices and so to change the quantity and quality of their produce. Sixty cocoa farmers in the Suhum cocoa district of Ghana were given the option to choose between selling their cocoa in the conventional way or through a test-cum-fee process conducted by their regular LBC. The behavioural response of these sixty farmers was then compared to forty farmers who did not have a menu of prices. The test-cum-fee experiment allowed us to examine three issues: (1) to what extent does price differentiation increase the overall quality and quantity of supply per hectare?; (2) to what extent does price differentiation induce self-selection?; and (3) what socio-economic characteristics determine farmers' self-selection behaviour?

As a starting point, a historical overview is given of the institutional mechanisms that have been employed in previous years to motivate farmers to supply

quality cocoa beans and the circumstances which led to the failure of these policies. In Section 6.3 a theoretical model of a test-cum-fee pricing rule is presented that can illustrate self-selection behaviour among cocoa farmers. Section 6.4 discusses the empirical strategy and the collected data. Hypotheses derived from the theoretical model were tested using data obtained from a field experiment conducted in the Suhum cocoa district in the 2011/12 and 2012/13 cropping seasons. The results are presented and discussed in Section 6.5. The final section concludes the study and distils policy recommendations.

6.2 Historical overview of cocoa bean quality assurance in Ghana

In this section, a historical background of the institutional mechanisms that have been employed in Ghana at the farmgate level to ensure that farmers supply cocoa beans of the best quality is presented. These mechanisms include cooperative institutions, price differentiation, minimum quality standards, and certification. The discussion also points to factors that led to the success or failure of these mechanisms and provides a context for our test-cum-fee experiments.

6.2.1 Producer cooperatives

Since World War I, consistent export of quality cocoa beans has been central to government agricultural policy in Ghana. One instrument used by the British colonial government to achieve this goal was the formalization of already existing farmer groups into producer cooperatives (Ton *et al.*, 2008).[1] According to Cazzufi and Moradi (2010), the major aim for creation of these cooperatives was to coordinate farmers to supply cocoa beans with consistent quality characteristics. Farmers in producer cooperatives sold their produce through their organization. It was the duty of the cooperative then to bulk and upgrade the produce of their members to meet the quality standards of cocoa merchants. After the cocoa beans had been sufficiently upgraded, an Agricultural Officer from the government's Department of Agriculture was invited to test and grade the beans. Graded and sealed cocoa bags were then sold to private international merchants at either the minimum producer price or at a 6% quality premium (Cazzuffi and Moradi, 2010).

The grading activities of producer cooperatives thus served as a screening device for cocoa export merchants, who paid different prices depending on the quality grade or on other factors like transportation costs. Running parallel to the producer cooperative were independent farmers who sold their produce through specialized brokers. These brokers however purchased cocoa without regard to quality

[1] A new law, Cooperative Society Ordinance No. 4 of 1931, amended in 1937, was passed in 1931 to set the limits within which producer cooperative could operate.

characteristics.[2] A number of studies reveal that the screening process of the cooperatives resulted in a cocoa bean quality higher than that supplied by independent farmers (Nowell, 1938; Ton *et al.*, 2008).

6.2.2 Price Differentiation

The British colonial government expected that the screening process of cooperatives would gradually replace the system of selling cocoa through private brokers. However, between 1937 and 1957, a number of important events occurred in the cocoa sector of Ghana that re-shaped cocoa trading activities. For instance, in 1937 the international cocoa merchants formed an oligopolistic cartel to collude on minimum prices for farmers. Cocoa producers, who had been well organized through the growing numbers of cooperative societies, countervailed these cartel prices with boycotts and agitations. The colonial government responded by creating a new market system where cocoa trading activities were to be coordinated by a marketing board which was to buy all cocoa beans at differentiated prices based on quality grades, i.e. the Gold Coast Cocoa Marketing Board (now Ghana COCOBOD).[3] A new law, "The Cocoa Industry Regulation of 1950'', spelled out cocoa quality grading standards and a modality for differentiating prices based on grades. Furthermore, the law transferred produce inspection and grading responsibilities from the Department of Agriculture to the Quality Control Division of the Marketing Board. In 1953 the government finally introduced cocoa price differentiation which targeted both cooperatives and independent farmers.

The price differentiation policy collapsed the same year it was introduced, largely because of lack of trust, high operating costs, and a general lack of interest by international cocoa merchants (Amoah, 1998; Leiter and Harding, 2004). Trust problems arose on two levels. First, at the international level, chocolate manufacturers, cocoa grinding companies and merchants could not agree on what constituted bean quality. As explained by Leiter and Harding (2004), while manufacturers and grinders were interested in difficult to determine flavour characteristics, merchants could only guarantee a consistent produce with minimized physical defects. So, manufacturers and grinders did not pay a premium for quality. Second, at the production level farmers and cocoa graders could not agree on physical standards and test results. Consequently, cocoa sector actors (especially manufacturers) pushed against the policy of price differentiation (Gordon, 1976).

[2] The cocoa market in the 1930s was not under the supervision of a marketing board. About 10 international commodity merchants directly purchased cocoa beans from farmers for export.
[3] The Gold Coast Cocoa marketing Board (GCMB) presently known as the Ghana Cocoa Board (COCOBOD) was brought into being by the colonial law Ordinance No. 16 of 1947.

The cost of operating a price-differentiation scheme, related to grading, transportation, and covering remote areas, was too high as compared to the extra revenues obtained at the export market. The costs were also high because farmers supplied both good and poor quality grades for testing. Beforehand, it was erroneously expected that the new pricing policy would lead to self-selection among farmers. That is, farmers would be motivated to supply only cocoa of high quality for testing in return to the payment of higher prices.

6.2.3 Minimum quality standards with a bonus

When the price differentiation policy failed, the Cocoa Industry Regulations of 1954 was passed. The new law discarded the price differentiation component of the market but required the establishment of grading facilities in cocoa-growing communities across the country. The Cocoa Regulations of 1954 set a clear minimum quality standard, below which supply was not acceptable. The regulations also laid out punitive measures, including even jail terms for deliberate supply of cocoa below the minimum quality standard. Quality grading was implemented not only as an incentive mechanism for farmers but also to signal to the international cocoa market that Ghana is committed to guarantee the export of premium quality cocoa beans. A number of companies were licensed to purchase cocoa beans from farmers. Among these companies was the United Ghana Farmers' Cooperative Council (UGFCC), the umbrella union of the cooperative societies. By 1961, adopting the UGFCC as its farmers' wing, the Ghanaian socialist government directed that the council should be the sole licenced cocoa buyer. The operation of the UGFCC was not different from the earlier activities of cooperatives. The council purchased cocoa beans from both members and independent farmers at one price, upgraded the beans, and sold them to COCOBOD. Farmers were then paid a bonus by COCOBOD for supplying cocoa above the minimum quality standard (Kolavalli and Vigneri, 2011).[4]

After 1966, when the socialist government lost power, UGFCC and its cooperatives were confronted with organizational and managerial problems. Subsequent governments banned the UGFCC and stopped their purchasing activities. Farmers lost their capacity to organize themselves freely and their political clout was reduced. Furthermore, widespread corruption and mismanagement of cooperative funds were reported across the country. This led to organizational problems and of lack of trust. Eventually the cooperative structure collapsed. In response, COCOBOD tried to license more private buying companies to purchase cocoa on minimum quality standards at a uniform price. However, these private companies were unable to

[4] This bonus system evolved over time. Currently, farmers receive a bonus for supplying more of bigger-sized "main crop" cocoa beans

generate profit in the market. In 1978, a single state-owned buyer, the Produce Buying Company (CPC), was introduced. The CPC operated on the minimum quality standards and paid uniform prices for quality till the cocoa sector reforms in 1992.

Under the minimum quality standards Ghana was able to maintain consistent supply of quality cocoa beans to the export market (Acquaah, 1999). Grading activities at farmgate together with the punitive measures for supplying poor quality cocoa and the prospect of a quality bonus may have induced self-selection among farmers and ensured the supply of quality cocoa beans. In addition to farmers selecting themselves to supply good quality cocoa, the screening activities of cooperatives and/or CPC may also explain the consistency in the quality of cocoa beans COCOBOD received and exported up to 1992. Grading activities at farmgate also brought farmers and cocoa officers together to interact regularly on quality standards. This interaction led to learning among farmers about the best ways to achieve the required quality (Amoah, 1998).

6.2.4 Multiple mechanisms under liberalization

In 1992, as part of a gradual reform of the cocoa sector that started in 1984, the market was once again liberalized. COCOBOD set out regulations which governed the re-introduction of private companies into the internal market. Another step taken by COCOBOD was to abolish grading activities at farm-gate. Grading activities were to be carried out at district depots of licenced buying companies (LBCs). Quality grading was no longer an incentive mechanism for providing incentives to farmers. Licenced buying companies were to act as the new screening device. They were to buy cocoa which met minimum quality standards, upgrade the purchased beans, and forward quality grades to COCOBOD qualifying for onward export for an agreed upon margin. Cocoa beans which failed to meet minimum quality standards are either discarded or in some case sold at a lower price to companies licenced by COCOBPOD to purchase "waste cocoa". Waste cocoa purchases occur only in isolated parts of the cocoa belt o Ghana. COCOBOD continued to fix an annual guaranteed minimum producer price. Further price and non-price strategies were left to LBCs, including the decision to pay for higher quality grades (Fold, 2001).

Consequently, in the liberalized market, LBCs and international actors of the chocolate chain were able to employ different mechanisms to provide incentives for farmers to supply quality cocoa. In effect, cooperative structures and certification schemes emerged together with the minimum quality standards system. In previous chapters of this thesis, aspects of certification mechanisms for eliciting quality cocoa beans from farmers have been analysed (see Chapter 5). It was observed that traceability systems, where all cocoa beans can be traced to the farm where it was

produced, as well as payment of a premium over and above the market producer price were the main mechanisms of certification programs. These mechanisms ensured that the problem of asymmetric information that is inherent to the current minimum quality standards approach by COCOBOD was significantly reduced.

With LBCs free to choose their incentive structures, test-cum-fee mechanisms present a plausible alternative. The advantage of test-cum mechanisms is that they address the costs encountered by the government under the price differentiation market system (Section 6.2.2) while at the same time it reduces the cost of upgrading. In the following section, a theoretical model of a test-cum-fee pricing rule is outlined to demonstrate how it leads to the supply of higher volumes of quality cocoa at lower upgrading costs.

6.3 Model with a test-cum-fee pricing rule

To guide our quasi-experiment and empirical strategy, we present a simple model that illustrates how self-selection behaviour among cocoa farmers can be induced through a test-cum-fee pricing rule.

The model starts with assuming a population of cocoa farmers that supply cocoa beans of heterogeneous quality. Suppose each farmer knows the quality of the beans he or she supplies, e.g. through their employed production methods and exerted effort, but LBCs are unable to obtain this information before buying. Suppose there is a specific LBC that seeks to resolve this information problem by offering a menu of prices to farmers with two options. First, farmers can supply their cocoa beans in the traditional way, where their produce is subjected to a simple quality test and where they receive a producer price r_L for every bag that passes the test. This price is the same as what other LBCs pay. For simplicity, all cocoa beans produced by farmers are assumed to meet the standards of this simple test, so that their quality is at least of Grade II (lower than Grade I). Second, farmers may subject their produce to a more elaborate test that, to some extent, can determine whether the quality of a bag of cocoa beans is of Grade I. Cocoa beans that pass this test are rewarded with a higher price r_H per bag ($r_H > r_L$) and beans that fail receive the usual price r_L. To have their beans tested, however, farmers must pay a fee f per bag. The second option on the menu thus has a "carrot and stick" format (Mirrlees, 1997).

A number of crucial assumptions are made here about the power of the second option on the menu to predict the private information farmers have about their bean quality. Let q denote the quality of a bag of cocoa and $p(q)$ the true probability that this bag passes the elaborate test. To fix ideas, p is a strictly increasing function with $p(0) = 0$ and p approaches 1 if q goes to infinity. Suppose that farmers do not know this true probability of passing the test, but can make an estimate $\tilde{p}(q)$ of their own

probability of passing. For simplicity, this estimate is a weighted average of one half, representing a fifty-fifty guess, and the true probability:

$$\tilde{p}(q) \coloneqq \theta \frac{1}{2} + (1-\theta)p(q) \tag{1}$$

Parameter θ $(0 \leq \theta \leq 1)$ is a constant that indicates the degree of inaccuracy of individual perceptions. The higher θ, the less information a farmer has about the probability that his or her bag will pass the test. It is assumed that all farmers have the same perception parameter θ.

Given these assumptions, we now probe the question: which option does the farmer choose? A risk-neutral farmer will opt for the special test if the cocoa quality is such that the expected returns exceed the general producer price:

$$\tilde{p}(q)\, r_H + \big(1-\tilde{p}(q)\big) r_L - f > r_L, \tag{2}$$

which comes to

$$\tilde{p}(q)(r_H - r_L) > f. \tag{3}$$

Hence, a farmer will subject his or her beans to this test if the expected price premium $\tilde{p}(q)(r_H - r_L)$ is larger than the test fee.

Figure 6.1 illustrates the decision of a farmer with a bag of cocoa quality q by confronting the subjective probability of passing $\tilde{p}(q)$, indicated by the "S-curve", with the ratio of fee and price premium $(f/r_H - r_L)$. It is seen that if this ratio is such that

$$\frac{\theta}{2} < \frac{f}{r_H - r_L} < 1 - \frac{\theta}{2}, \tag{4}$$

there exists a positive cut-off level $\hat{q}$ such that farmers with cocoa beans of quality less than $\hat{q}$ will supply their beans in the traditional way and receive r_L, while farmers with beans of quality more than $\hat{q}$ will pay the fee and subject their beans to the special test. Hence, farmers at the lower tail of the quality distribution will turn down the second option because it is likely that their cocoa will be rejected by the special test, so that they will end up with both the cost of paying the fee and the low price r_L. An appropriate combination of prices and fee thus can induce such self-selection on the part of farmers that applications with low-quality bags are discouraged.

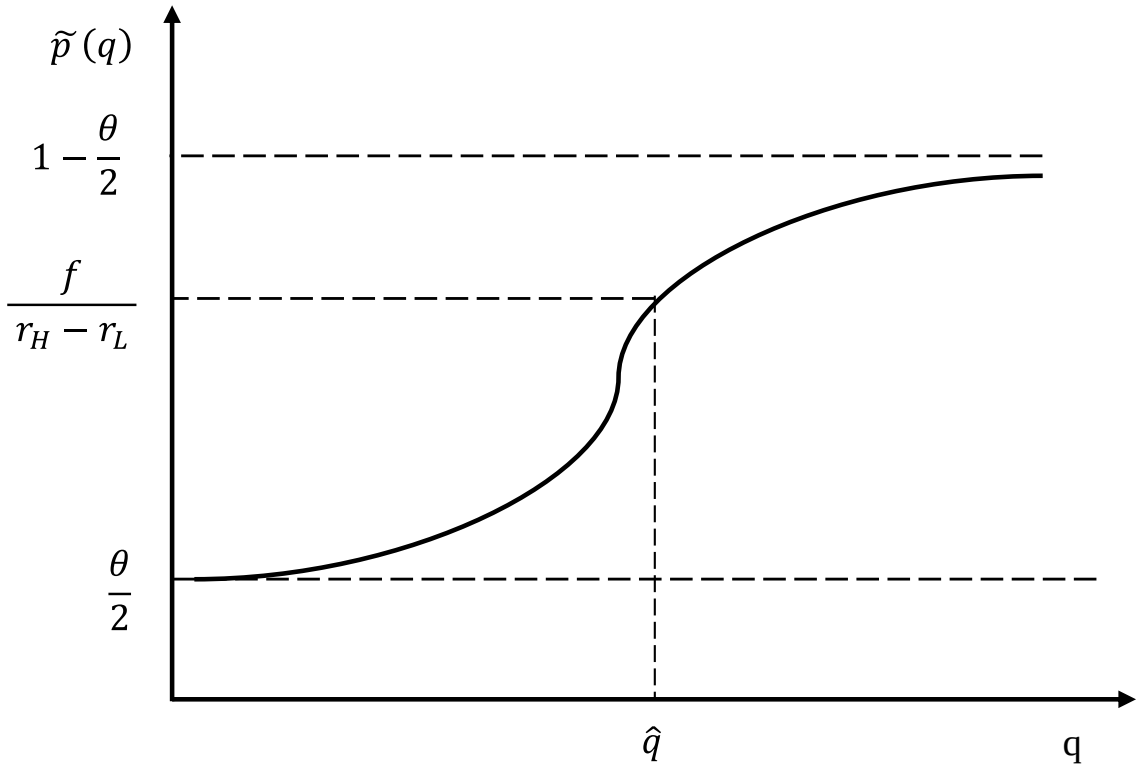

Figure 6.1 The self-selection mechanism

Inspecting equations (3) and (4), we see a number of conditions that are crucial for creating this self-selection. First, the LBC must demand a positive fee, i.e. $f > 0$. If there was no fee, all farmers would apply for the special test. Second, farmers must have some knowledge about the true test scheme ($\theta < 1$). If $\theta = 1$, so if farmers guess that the passing probability is fifty-fifty, the LBC cannot create any self-selection with their pricing rule. Third, the price premium $r_H - r_L$ the LBC offers on top of the producer price must not be too high, nor must the fee be too low. Otherwise, a risk-neutral farmer will not apply. Similarly, a too low price premium or a too high fee would deter all farmers from applying, making the special-test option redundant. Finally, note that if farmers would be risk averse, a given combination of price premium and fee would result in fewer applications for the special test as compared with the case of risk neutrality, since farmers then also demand compensation for taking the risky option.

What are the welfare implications for farmers and LBC? Farmers who face these two options could improve their payoffs. Those who choose the standard option are equally well off as before, when the LBC did not provide the alternative. Those who apply for the special test option are clearly better off in an ex ante sense (otherwise they would not have applied). Ex post things are different. Farmers whose

beans are rejected receive $r_L - f$ per bag and when accepted they receive $r_H - f > r_L$.

Creating self-selection on the part of the farmers favours the LBC for two basic reasons. First, fewer bags of cocoa are now supplied for testing. So the costs of carrying out the special test are lower (granting that the fee is less than the individual test cost). Second, the sorting of beans into a low-quality and high-quality class enables the LBC to cut upgrading costs. In practice, after buying the cocoa beans, any LBC has to upgrade the cocoa beans in order to be able to sell it at a uniform price to COCOBOD.[5] We can safely assume that the upgrading cost of a bag of cocoa falls, when grading has been carried out already. For example, suppose beans beyond quality q* do not need to be upgraded. Then offering a price premium and fee such that $\tilde{p}\,(q^*)(\,r_H - r_L\,) = f$ implies that only the class of low-quality beans requires upgrading.

These are gains that apply to a given production. More importantly is the observation that over time farmers and LBC can increase their gains, because farmers will have an incentive to improve their production practices and efforts to increase the quality of their supply and so submit more beans for testing.

6.4 Empirical strategy

6.4.1 Quasi-experiment and data

The central aim of this study was to test if farmers will select themselves to supply higher volumes of quality cocoa beans when they are able to sell in differentiated markets. We therefore exposed a number of farmers to a menu of price options. These farmers could sell any proportion of their produce to a selected LBC either in the traditional way or through a test-cum-fee application as described in the theoretical model. The response of these "treated" farmers, in terms of the quantity and quality of cocoa beans supplied, was then compared with farmers who received a uniform price for all quality grades. This quasi-experiment was conducted in the Suhum Cocoa District from November to April in the 2011/12 cropping season and repeated over the same period in the 2012/13 cropping season.

As discussed in Section 6.3, self-selection behaviour depends partly on the price of higher quality grades (r_H) and test fees (f). To ensure that these parameters were realistic before the menu of prices were offered, a group discussion was organized with farmers, extension officers, and cocoa buyers. The discussion used information on the premium payments by other organizations, some of the findings in our previous studies (see Chapter 3), outcomes of previous stakeholder workshops,

[5] Upgrading activities of LBCs include bulking all cocoa beans purchased, sorting out poor quality cocoa beans and other foreign material, and re-drying when the produce is not sufficiently dried.

and experiences of LBCs and farmers. Based on these consultations the following parameters were set:

Quality standards: For the purposes of this study, two quality grades were defined. A bag of cocoa was classified as Grade I if it contained less than 25% physical defects. Otherwise, it was marked as Grade II. The standard "Cut test" was employed to determine the level of physical defects. This test involves sampling a quantity of beans from each side of the cocoa bag. 100 beans are randomly selected from this sample. Each bean is cut lengthwise through the middle in order to expose the surface of the cotyledons. Both halves are examined in full daylight to assess whether it contains any physical defect (Schwan, 1998). A count was then made of the non-defective beans to determine the quality score.

Test fee: A one kg fee was charged for every standard 62.5 kg bag submitted for the Cut test. The literature suggests that 1 kg per bag is the generally accepted limit to which farmers are willing to pay for levies and fees (Baah, 2008).

Prices: For r_L, we took the current market producer price. r_H was set at 105% of this price (i.e., $r_H = r_L + (0.05 \times r_L)$), implying a price premium of about 3 kg for every standard bag of cocoa.

A couple of months before the start of the experiment, farmers were informed about the test-cum-fee option. Test-cum-fee activities were carried out once a month during the experimentation period. Practically, during the cocoa season, farmers had cocoa beans ready for the market almost every week. We therefore took measures to avoid denying them of their incomes. When the situation arose such that their cocoa beans were ready for sale before the test-cum-fee process opened, the 1 kg fee was charged, and the produce was assessed for dryness and other criteria carried out in the traditional market. Farmers were then paid the regular producer price r_L. A sample of their beans was taken and stored. On a typical day of test-cum-fee, every produce submitted so far to test-cum-fee was subjected to the standard cut-test and eventually the price premium was paid. In control communities, we allowed the traditional process to go on uninterrupted. Farmers were paid r_L for every bag of cocoa beans sold. Samples were taken from farmers' beans for testing.

A two-step approach was followed to assign farmers into treated or control groups. First, four farmer based organizations (FBOs) were selected from different communities that are at least 5 km apart. The FBOs were selected on a number of criteria. First, they were to have enough members from which we could sample up to 20 members. Second, two of the four FBOs had to be involved in our earlier participatory farmer research on quality-enhancing good agricultural practices (Chapter 4). Finally, the FBOs were to have one buyer to whom the majority of their members already sold their beans to. We chose to work with FBOs because it was

easier to organize farmers.[6] Based on these criteria, we selected the FBOs in the villages of Duodukrom and Anum Asuogya with whom we had already worked during the farmer participatory research. One FBO in each of the villages of Otwe and Besease, which were not part of our participatory research activities, were also selected. The FBOs in Duodukrom and Besease were treated with the menu of prices while those in Otwe and Anum Asuogya were left as control. In each of the FBOs we sampled a random subset of farmers to obtain data for our analysis.

Before proceeding to the data gathered from this quasi-experiment, a few design issues and limitations which came up deserve discussion. First, we did not have data on an alternative menu of prices. Hence, the analyses presented in this paper strictly apply to one specific combination of test fee (1kg) and price premium (3kg). This implies that other combinations of fee and price premiums may have resulted in different self-selection outcomes. Second, the timing of announcement of the menu of prices to farmers in the first season was rather late, as most of the production investment decisions had been made by farmers in earlier months, although they could still work on the quality of their produce through their post-harvest practices. Hence, it was expected that the first year would be a learning phase, where farmers could also become familiar with the test-cum-fee option and the accuracy of the test, while the second year could generate much clearer results. Finally, we were unable to estimate correctly the volume of beans a farmer sold to other LBCs than those we worked with. Hence the variable "cocoa beans supplied" in this chapter does not necessarily refer to total production.

Data were obtained from 60 treated and 40 control farmers, so 30 from each treated village and 20 from each control village. Self-selection behaviour was indicated by the proportion of the total yearly supply of cocoa beans by a farmer that is submitted to test-cum-fee. Hence, the main data of interest were the total volume of cocoa beans supplied, proportion of this amount submitted to test-cum-fee, and their quality scores. It was also expected that exogenous socio-economic characteristics to influence farmer behaviour. Therefore, a semi-structured questionnaire was employed to elicit information about farmers household and farm characteristics at the beginning of the program.

6.4.2 Methodology

The first exercise of this paper was to assess the extent to which exposure to a menu of prices improves the overall quality and quantity of cocoa beans supplied. To achieve this we employed difference-in-difference estimation which allowed us to

[6] Opening the test-cum-fee treatment to the entire community implied paying quality premiums which were beyond the budget of this PhD research.

estimate an "average treatment effect" by comparing the average change in quantity and quality of cocoa beans supplied by farmers. This approach allowed us to estimate the changes in supply and quality attributed to the introduction of a menu of prices. The theoretical model presented earlier suggests that a necessary condition for self-selection is exposure to the test-cum fee option. How much self-selection takes place depends on farmers' risk preference, perception about the test, and production. Hence we estimated a regression model which controlled for these factors in order to obtain the true treatment effect.

Next, the study focused on farmers who were exposed to a menu of prices. We assessed their self-selection behaviour by first plotting a kernel density distribution function (Figure 6.2). From the density function, we could a binomial pattern of self-selection behaviour among farmers facing a menu of prices could be observed One set of farmers supplied about half of their produce to test-cum-fee while another set supplied most of their beans.

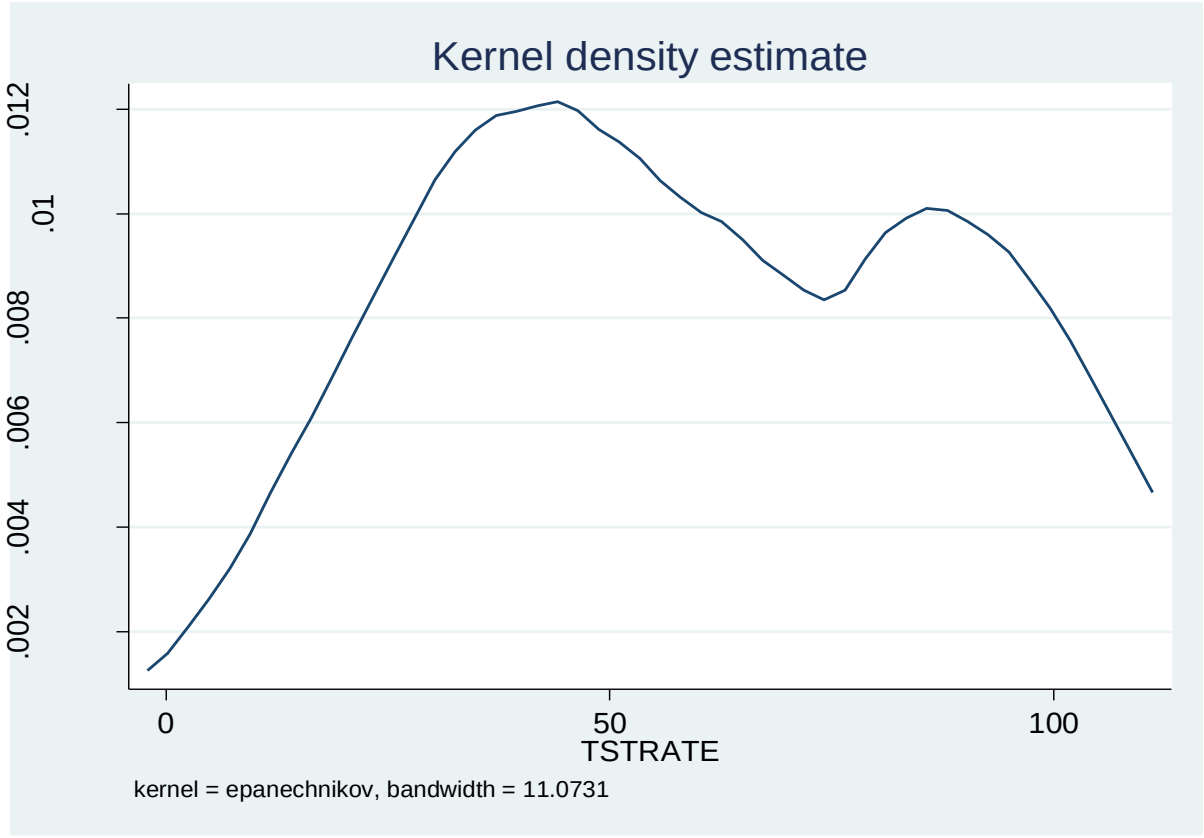

Figure 6.2 Distribution of proportion of supply submitted to test

Following this distribution, we run a logistic regression to predict the effect of socio-economic characteristics on self-selection behaviour in the presence of a menu of prices. Our theoretical model suggests that self-selection behaviour is influenced by individual risk preference, perception and understanding of the test properties, and

production capacities. The socio-economic characteristics would presumably give us an indication of the effect of these parameters. The logistic regression analysis with self-selection behaviour as dependent variable and the socio-economic characteristics as independent variables was performed using the *logit* commands of Stata 12.0 software as follows:

Given a farmer with characteristics $X_1, X_2 \ldots, X_m$

$$\mathrm{P_i} = \mathrm{P}(\delta_\mathrm{i} = 1|\mathrm{X_1}, \mathrm{X_2} \ldots, \mathrm{X_m}) = \frac{1}{1+\mathrm{e}^{-(\alpha+\beta_1 X_{i1}+\beta_2 X_{i2}+\cdots+\beta_m X_{im}+\varepsilon_i)}}, \qquad (11)$$

which transforms into

$$\mathrm{Log}[P_i/(1-P_i)] = \alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_m X_{im} + \varepsilon_i, \qquad (12)$$

where α is a constant, β_j represents the coefficient of jth independent (continuous or dichotomous) variable X_{ij} of farmer *i (j = 1, 2….m*). The dependent variable δ_i is an ordered dichotomous variable representing 0 and 1 if the farmer submitted up to 75% and more than 75% of total supply to test-cum-fee, respectively.

A number of independent variables entered the regression. These variables were grouped into three sets: a first one consisting of variables that presumably indicated risk preferences, a second set with variables that were likely related to farmer's perception of the test and understanding of the new price mechanism, and a third set consisting of variables that possibly indicated the degree to which farmers were constrained in producing quality cocoa.

Underlying the first set with risk-preference indicators was the intuition that the test-cum-fee option implies risking the test fee. Hence, among farmers with the same volume of quality cocoa, those with less risk aversion are likely to supply a higher proportion to this option. The risk preference variables included age, gender, experience, farm size, dependence on cocoa, share crop status, and size of farm holding. Age was captured in years. Our hypothesis was that younger farmers were less risk averse (or more risk-loving). Hence, we expected that self-selection behaviour decreases with age. The gender variable was dichotomous, 1 for male and 0 for female. Women were expected to take fewer risks than men, hence, self-selection behaviour was expected to be higher among male farmers. Dependence on cocoa may also influence risk preference. This dependence factor was captured by a number between 0 and 100 representing the proportion of cocoa in family income. As we did not have a way of estimating a farmer's real income, we simply asked them to make an estimate of this percentage. It was hypothesised that farmers who depend more on cocoa will be more cautious about losing income through the fee, and so will show less self-selection behaviour. Sharecropping was defined as a dichotomous

variable which stated whether a farmer owned all his farms (value is 0) or sharecropped some of them (value is 1). The behaviour of sharecroppers should be analysed with caution since it may depend on their interaction with land owners. Holding this omitted variable constant, however, land owners were expected to have the freedom to take more risks than share croppers. Similarly, farmers with larger holdings were expected to be able to take more risks associated with losing cocoa beans (which is implied by the test-cum-fee price menu) and hence supply a higher proportion of their beans to test-cum-fee.

The second set of variables consists of indicators that could have influenced farmers' perception about the new price mechanism (formalized by θ in Section 6.3). Perception-related variables included education and migration. Education represented the number of years of formal education. It was expected that more educated farmers would find it easier to understand the mechanism of test-cum-fee and hence supply more of their beans to the special test. Migration is a discrete variable which defined farmers as originating from the villages they live in (value is 1) or migrants from other communities (value is 0). Coming from different backgrounds may affect the social groups and networks farmers join and the extent to which they discuss the test-cum-fee option on the menu (Zetlin, 2009). We did not have an a priori expectation of this variable as it is difficult to predict how farmers in different circles perceived the test-cum-fee option.

The third set of variables relates to factors which constrain farmers' capacity to supply higher quality cocoa beans. Holding risk preference and perceptions about the test-cum-fee process constant, our theoretical model suggests that farmers will not apply for testing if they do not have cocoa beans which meet the higher standards. Variables which we expected to constrain farmers' supply of quality produce were household size, participation in participatory research, and experience. Supply of quality cocoa beans involves many steps, particularly post-harvest activities of pod breaking, fermentation, drying and polishing (Dongo and Sogwa, 2009). These activities normally involve the use of household labour (Abenyega and Gockowski, 2003). Hence, other factors held constant, we expected that farmers in bigger households will have extra hands to take care of their cocoa which will allow them to supply cocoa of higher quality. Taking part in our previous participatory research program built the capacity of farmers to enhance the production of quality cocoa beans (see Chapter 4). Hence, in line with our findings in Chapter 4, we expected that participants would supply a higher proportion of their produce to test-cum fee compared to those who were trained under the conventional extension system. Similarly, we expected experienced farmers to be able to take better care of

their cocoa, produce more quality beans, and supply a higher proportion to test-cum-fee.

Finally, although we allocated the variables to three different sets, we also expected certain variables to play a role in more than one category. For instance, while educated farmers may form better perceptions about the test-cum-fee option on the menu than less educated farmers, they are probably also able to better manage the quality of their produce and take calculated risks. Farmers with big household may have better capacity to manage quality than those with a small household, but also have more need for income and hence be cautious about losing revenue through the test-cum-fee option.

6.5 Results

6.5.1 Response of supply and quality to a menu of prices

The influence of introducing a menu of prices on the supply of cocoa beans and on their quality is explored in Table 6.1, using non-parametric difference-in-difference estimates. Per hectare, both treated and control farmers in the experiment significantly increased the average supply of cocoa beans to the LBC in the second season compared to the first.

Table 6.1 Change in quantity and quality of cocoa bean supply per hectare among farmers in the entire sample[1]

	Kilograms per hectare			Quality scores		
	Treated farmers [A]	Control farmers [B]	Diff. [A-B]	Treated farmers [A]	Control farmers [B]	Diff. [A-B]
Season 1 [C]	275.3	235.2	40.1	69.3	67.0	2.3*
	(136.02)	(210.04)		(4.15)	(3.51)	
Season 2 [D]	322.9	342.3	-19.4	74.2	69.2	5.0*
	(180.94)	(496.3)		(3.30)	(5.304)	
Difference [D-C]	47.6*	107.1*	-59.5	4.9*	2.2	2.7*

[1] Figures represent means. Standard deviations are in parentheses. Estimated mean attributed to the treatment is given by [(A-B) - (D-C)]. *p<0.05

Yet, the difference between these two increases cannot be attributed to the menu of prices; the treatment effect was not statistically significant at the 5% level. Recall that the limitations of our data do not allow us to draw conclusions on the

effect of the menu of price treatment on production. However, the price menu opportunity resulted in a significant increase in quality scores of cocoa beans supplied by treated farmers compared to control farmers. Treated farmers increased the quality of their beans significantly (from 69% to 74%) in the second season compared to the first, while for control farmers it remained similar. Therefore, the introduction of the price menu significantly raised the quality of cocoa supplied by 2.7 percent.

In Table 6.2, we explore the extent to which the observed change in quality scores between control and treated farmers is confounded by socioeconomic variables. In column (1) we report Ordinary Least Squares (OLS) regression results for the first season in which the experiment was held and in column (2) OLS regression results for the second season. The data sets were separated because we suspected farmers' response to be more realistic in the second season due to the design issues (see Section 6.4.1).

For both OLS specifications we observe a significant positive relationship between exposure to a menu of prices and average quality of cocoa beans per hectare. Socioeconomic variables of interest here are previous involvement in our farmer participatory research (see Chapter 4), migration status, and the extent to which farmers depended on cocoa as a source of livelihood. In both seasons, farmers who had previously learnt about quality-enhancing practices supplied a significantly better quality of 4 percent points more compared with farmers who did not join the learning program. Whereas in the first season indigenes responded differently from migrants by supplying a lower quality of their produce, in the second year there was no significant difference in supplied quality. In the second year, we observed a positive significant relationship between dependence on cocoa and the quality of cocoa beans supplied. This could be explained by the strong commitment of people who depend on cocoa for their livelihood.

In column (3), we estimate the change in cocoa quality between the first and second season attributable to our treatment while controlling for other characteristics (by ignoring design issues and pooling the data in order to regress the quality score of the farmer on their socioeconomic characteristics and a time variable). The results confirm our findings in Table 6.1 that due to the menu of prices, cocoa farmers in the study area increased their cocoa bean quality significantly by 3 percent points. The results are similar to those in the first season, but only migrants and indigenous farmers did not differ in the extent to which they improved their cocoa bean quality over time. Similar to the results of the second season, dependence on cocoa had a significant and positive effect on quality over the experimental period.

Table 6.2 Results of regression of quality of cocoa beans supplied by farmers

	OLS (1)	OLS (2)	OLS (3)
Constant	65.111	63.892	62.443
	(2.686)*	(2.910)*	(1.991)*
Treatment with price menu	2.939	3.153	3.036
	(1.297)*	(1.401)*	(0.955)*
Season			4.221
			(0.514)*
Involved in participatory research	3.955	3.911	3.939
	(1.208)*	(1.286)*	(0.881)*
Age	-0.014	-0.005	-0.005
	(0.039)	(0.041)	(0.028)
Sex	-0.124	-1.498	0.703
	(0.972)	(1.044)	(0.713)
Household size	0.104	-0.131	0.117
	(0.139)	(0.149)	(0.102)
Migration status	-1.879	-0.381	-1.123
	(0.880)*	(0.947)	(0.646)
Education	-0.067	-0.002	-0.033
	(0.132)	(0.142)	(0.097)
Size of other farms	0.004	0.015	0.011
	(0.120)	(0.129)	(0.088)*
Dependence	0.008	0.047	0.027
	(0.017)	(0.018)*	(0.012)*
Experience	0.032	-0.002	0.014
	(0.033)	(0.035)	(0.024)
Off-farm income	-1.084	-0.095	-0.590
	(0.802)	(0.861)	(0.589)
Share crop	-0.941	-0.438	-0.682
	(0.830)	(0.902)	(0.612)
Size of cocoa farm	0.093	0.094	0.091
	(0.059)	(0.078)	(0.047)
Sample size	97	97	194
Adjusted R^2	0.222	0.297	0.408
F	3.11*	4.12*	10.50*

OLS refers to Ordinary Least Squares regression method. Dependent variable = quality score (ranges between 0-100). Standard errors are reported in parentheses. *p<0.05.

6.5.2 Self-selection behaviour

The evidence compiled in the previous tables confirms an overall improvement in quality in the presence of price differentiation with test-cum-fee. However it does not reveal whether farmers will opt to sort out the best quality cocoa beans for sale. To

address this issue, we turn our attention to only farmers who received the menu of prices (the treated farmers). The proportion of cocoa beans these farmers submitted to the test-cum-fee option rather than to the single-price option was compared (Table 6.3). It was already found that over the two seasons, the total supply per hectare of cocoa beans did not change significantly (Table 6.1). However, the average amount submitted to the test-cum-fee option per hectare went from 95 kg in the first season to 202 kg in the second. Proportion wise, farmers submitted about 35% of their produce to the test-cum-fee option in the first season, and this significantly increased to 63% in the following season.

Table 6.3 The amount of cocoa beans as part of the total (kg/ha) submitted to test-cum-fee option (n=60)[1]

	Yield per hectare [A]	Amount submitted to test-cum-fee [B]	Difference [A-B]	Proportion
Season 1 **[C]**	275.3 (136.02)	95.5 (264.42)	179.8	34.85
Season 2 **[D]**	322.9 (180.94)	202.2 (635.11)	120.7	62.63
Difference **[D-C]**	47.6*	111.7*	-59.1	27.78*

[1] Standard deviations are in parentheses. *p<0.05

Table 6.4 indicates the impact of the self-selection behaviour of treated farmers on the quality of their produce, by comparing the quality score of beans submitted to the test-cum-fee option and that submitted to the single-price option. Over the two seasons, the average quality score of beans supplied to the test-cum-fee option increased significantly by 7 percent points. This significant increase was 3 points more than the change (although also significant) in average quality score of the beans submitted to the simple test that goes with the single-price option.

The result in Table 6.3 further shows that in the first year, there was no significant difference in the qualities of cocoa beans submitted to both options on the menu. As we discussed in Section 6.4.1, this observation showed that farmers were probably trying out the new market arrangement. A serious application of the test-cum-fee process was in the second season. Table 6.5 therefore reports the results of a logistic regression using data from the second season to explain the determinants of the self-selection behaviour observed in Table 6.3 and 6.4.

Table 6.4 Comparison of quality of cocoa beans submitted by the treated farmers to test-cum-fee option and single price option (n=60)[1]

	Quality scores of beans submitted to test-cum-fee option [A]	Quality scores of beans submitted to single-price option [B]	Difference [A-B]
Season 1 [C]	69.7	69.1	0.6
	(5.24)	(4.47)	
Season 2 [D]	76.7	73.1	3.6*
	(5.60)	(4.20)	
Difference [D-C]	7.0*	4.0*	3.0*

[1] Figures represent means. Standard deviations are in parenthesis.*p<0.05

The dependent variable is an ordered dichotomous variable that captures the two patterns of self-selection behaviour pictured in Figure 6.2. It equals 0 if the farmer submitted up to 75% and equals 1 if the farmer submitted more than 75% of his or her total supply to test-cum-fee (see Section 6.4.2). Holding other factors constant, farmers who took part in the participatory research were 71% more likely to supply more than 75% of their total supply to the test-cum-fee option, as compared with farmers who did not have this training. Similarly, farmers with one more household member were 4% more likely to supply such a high proportion to the test-cum-fee option. Farmers with an extra year of formal education were 7.5% more likely to submit such a high proportion for testing. Another variable with a significant positive sign was the size of the cocoa farm. Cropping an extra hectare of cocoa farm increased the probability of supplying more than 75% for testing by almost 2%. Also migration status influenced the extent of self-selection behaviour. Farmers who migrated to the treated communities in the past were 29% more likely to supply a high proportion for testing, as compared with indigenes.

An outcome in Table 6.5 was that farmers who depend on cocoa were likely to exhibit more self-selection behaviour rather than less. As discussed in Section 6.4.2, we expected such farmers would be more cautious about losing income through the fee, and so would opt more for the single-price option. Yet the results (Table 6.5) suggest that farmers whose proportion of cocoa income in total income is 1% higher than that of other farmers were 0.6% more likely to supply more than 75% of their beans for testing.

Table 6.5 Logit estimation of the determinants of self-selection behaviour among "exposed farmers"

	Marginal effects
Involved in participatory research	0.714
	(0.145)*
Age	-0.001
	(0.005)
Sex	0.084
	(0.122)
Household size	0.042
	(0.022)*
Migration status	-0.293
	(0.127)*
Education	0.075
	(0.035)*
Size of other farms	0.038
	(0.028)
Dependence	0.006
	(0.004)*
Experience	-0.182
	(0.190)
Share crop	0.135
	(0.129)
Size of cocoa farm	0.019
	(0.111)*
Observations	60
Pseudo r square	0.400
LR chi-square	30.51*

Dependent variable equals 0 if the farmer supplied to 75% and 1 if the farmer supplied more than 75% of total supply to test-cum-fee (see Section6.4.2). *p<0.05. Standard errors are reported in parentheses.

6.6 Discussion and Conclusions

Overall, our results reinforce the argument made by several authors that, whereas Ghana is a net producer of premium quality cocoa beans, Ghanaian cocoa farmers can still do more (Hainmueller *et al.*, 2011; Williams, 2009; Osei, 2007; Laven *et al.*, 2007). Extensive evidence exists to support the idea that farmers respond significantly in terms of output to price changes (Armah, 2009; Bateman, 1965). We contributed to

this evidence by filling a hitherto unexplored gap. We showed that in the presence of a governance structure (specifically a menu of prices) that directly addresses the problem of asymmetric information, farmers significantly improve cocoa bean quality. This result provides empirical support for a number of studies which have previously argued for price differentiation by quality in the cocoa market (Leiter and Harding, 2004). This literature however ignores one basic pitfall: rewarding producers of better quality cocoa financially without imposing some direct form of punishment or cost on bad performers may not yield the desired results. We therefore assessed the impact of a governance structure that blends both punishments and rewards in a "carrot and stick" fashion on farmers' response in terms of supply of quality produce. We observed that the test-cum-fee aspects we built in our price differentiation mechanism signalled the prospects of a fair reward to farmers and, hence, elicited increased effort from the majority of farmers towards enhancing bean quality. This explains why cocoa beans supplied to both options on the price menu exhibited improvement over time.

Following our theoretical model, the finding of significant positive self-selection behaviour (i.e., a high proportion of total supply submitted to the test-cum-fee option of the price menu) can be explained in three ways. First, given similar yields, farmers with different ability to learn or form different perceptions about the new price mechanism will make different choices. Specifically, a better informed farmer will show more self-selection behaviour. One factor which expands a farmer's scope of inference as well as his ability to access and process agricultural information is education (Meenambigai, 2003). We indeed observed that farmers with more years of formal education exhibited more self-selection behaviour. In their study on Ghanaian cocoa farmers, Baffoe-Asare et al. (2013) have argued that extra training in farm practices re-enforces farmers' experience and up-grades their ability to learn about innovations. This may explain why farmers who were involved in our previous participatory research activities engaged more in self-selection, as they presumably were more able to understand the implications of the test-cum-fee option than non-participants. Farmers' ability to learn and their perceptions may also improve with their social interactions. According to Zetlin (2009), who studied technology adoption behaviour of Ghanaian cocoa farmers, migration status influences the social networks of producers. It is likely that discussions among farmers belonging to different social groups or ethnic groups may result in different views on the new pricing rule. This may, to some extent, explain the observed difference in the self-selection patterns between indigenous and migrant farmers.

For a better understanding of their different responses, we turn to the second explanation of the observed self-selection behaviour: the role of risk preferences. The test-cum-fee pricing rule necessitates risky decisions by farmers. As we observed in

Chapter 4, a quantity of cocoa beans from farmers will always contain some defective beans. Opting to sell cocoa through the test-cum-fee option therefore implies a risk of failing the test and thus losing the test fee. Hence, in addition to differences in information, and divergent risk preferences among farmers may explain the observed pattern of self-selection. Hill (1997) has chronicled how cocoa farming in Southern Ghana (including our study area) was developed through capitalist migrants. One would therefore expect that migrant farmers will be more adventurous in exploiting price differentiation. This was confirmed by our data. Some literature also suggests that in general Ghanaian cocoa farmers, most of them being smallholders, are risk-averse (Aneani *et al.*, 2012; Laven and Boomsma, 2012). With such a risk-averse disposition, it is not surprising that smallholders were less responsive to our menu of prices compared with farmers with large holdings. Farmers who depended more on cocoa for their livelihood exhibited more self-selection, this is in contrast to our a priori expectations that assumed that such farmers would be more risk averse. Perhaps these farmers take more care of their beans than farmers since they do not have much diversified sources of income.

The third strand of explanations relates to the presence of constraints hampering the supply of quality cocoa beans. Farmers who face fewer constraints are more able to exploit the opportunities of the new price menu and so to engage in self-selection behaviour (other things equal). Hence, granting that educated and trained farmers have a relatively better capacity to produce quality cocoa, this explains why these categories of farmers exhibited more self-selection behaviour. Our results also show that farmers in bigger households, who potentially have easier access to extra hands to sort out cocoa beans, engaged more in self-selection. A similar reason explains our finding that large-scale farmers exhibit much self-selection behaviour. Apart from being less affected by the risk of losing test fees, large-scale farmers have relatively high financial resources to hire extra hands to carry out some of the quality-enhancing functions.

What are the implications of a governance structure that employs price differentiation with a test-cum-fee option for cocoa buyers in Ghana? According to Tollens and Gibert (2003), the increasing liberalization of cocoa markets in West Africa from state control to private participation has led to transfer of some quality-enhancing functions to cocoa buyers. This shift in functions means that LBCs must spend resources to upgrading cocoa beans purchased from farmers in order to meet the high quality standard specification of COCOBOD (Quarmine *et al.*, 2012; Williams, 2009; Tollens and Gilbert, 2003). The general increase in average quality per hectare found in this study suggests that price differentiation with test-cum-fee could significantly reduce upgrading cost of LBCs.

Quarmine et. al, (2012) observed that the changing organization of the cocoa market increases the burden on LBCs to procure quality cocoa beans. Yet it appears they are reluctant to examine the potential of governance structures that employs price differentiation by quality. One explanation for this reluctance may be the narrow selling margin within which they must operate (Laven, 2010). LBCs also may not have the financial capacity to operate such governance structures (Fold, 2001). Moreover, cocoa laws and regulations anyway limit the space within which LBCs can implement alternative governance structures. For instance, COCOBOD neither provides LBCs a premium for every unit of superior quality cocoa beans purchased nor allow LBCs to fully exploit the international market where they may sell their cocoa at a higher price. Successful implementation of alternative governance structures by LBCs to address asymmetric information problems may also depend on the level of trust they can build with farmers. In sum, given all these limitations, the question of how far can LBCs goes to address asymmetric information problems arises. The bottom line of this study is that there are win-win opportunities left unexploited; benefitting both farmers and LBCs, once the hurdle of price differentiation by quality is taken.

A number of final remarks are in order. Given this opportunity for a win-win situation through price differentiation, policy makers need to focus on continuously analysing the market and experimenting with more alternative governance mechanisms if Ghana is to sustain its position on the world market as a net exporter of quality cocoa beans. This study is a pioneer in the field of asymmetric information in Ghanaian cocoa and agricultural markets for that matter. However, there are two limitations of this study which could be improved in future studies. First, the sample size on which the analysis was conducted is relatively small. Even though we believe the results are scalable, a much bigger sample over a longer time period may generate more robust and externally valid results. Second, this study was strictly limited to a specific test-fee combination. More investigation is required to test the optimal combination of test fee (stick) and price premium (carrot) which elicits the best results.

Chapter 7

Discussion and Conclusions

7.1 Introduction

Two broad observations from previous research on the behavioural patterns of smallholder cocoa farmers in Ghana motivated the studies presented in this thesis. First, Ghana seeks to remain the supplier of the bulk of the world's premium quality cocoa beans. To achieve this objective, farmers need to commit themselves to specific recommended technologies and production activities (Anim-Kwapong et al, 2007). Yet, there is evidence that smallholder farmers (SHFs) in Ghana have not adopted more than 4% of recommended quality-enhancing technologies (Aneani et al., 2012). Second, institutional factors (formal regulations, laws, policies, informal norms, standards, forms of organization) have often been hypothesized to determine the decision of farmers to take up these technological recommendations. However, until now research has paid only little attention to institutional factors that influence farmers' willingness and capacity to further enhance the quality of their produce. Hence, at the moment not much is known about how institutions undermine or promote the supply of quality cocoa beans in Ghana.

This thesis employed perspectives of institutional economics, mechanism design theory, and other social science tools to empirically investigate how institutions structure incentives for SHFs to enhance the production of quality cocoa beans. Five specific research questions were addressed in separate empirical chapters: (1) how did macro-level institutional reforms influence the incentive structures embedded in producer prices? (2) which institutional factors constrain SHFs from enhancing the production of quality cocoa beans? (3) given current market structure, to what extent will farmers who have taken part in participatory research activities enhance their cocoa bean quality? (4) how do the incentive mechanisms of certification programs influence farmers' effort to enhance the quality of cocoa beans they produce? (5) to what extent do farmers respond to price differentiation with a test-cum-fee option in terms of supply of higher volumes of quality cocoa beans?

The empirical evidence provided in this thesis led to a number of conclusions about how to motivate farmers to enhance the quality of their produce through institutional mechanisms.

1. Formal macro-level institutions influence the level of risk and uncertainty farmers face and hence their incentive to apply more effort to their production activities.

2. At the micro level, a mix of formal and informal institutional factors undermine SHFs' incentive to enhance the production of quality cocoa beans. A major institutional factor is the presence of asymmetric information in the cocoa market.
3. Changing farmer knowledge institutions alone, without re-organizing the market, results in adoption of yield-enhancing rather than quality-enhancing technologies.
4. To improve the quality of their produce beyond current levels, buyers and policy makers need to design market governance arrangements that directly address existing problems of asymmetric information.
5. One market governance structure that significantly motivates the supply of enhanced quality cocoa beans is certification of Farmer Based Organizations (FBOs). When certification programs implement traceability systems, the problem of asymmetric information is largely solved.
6. The asymmetric information problem can also be significantly reduced through price differentiation with test-cum-fee mechanisms.

Below, these contributions to the literature are discussed in detail.

7.2 Summary and discussion of main conclusions

7.2.1 Diagnosing the problem

A couple of diagnostic studies were conducted to identify and assess the impact of institutional factors, and how they have evolved over time, on the behaviour of cocoa farmers in Ghana. Of particular interest were the incentives for farmers to enhance the production of quality cocoa beans.

Price-setting institutions influence SHFs' incentive to produce cocoa

In this thesis, diagnostic studies started with a macro-level analysis of how the evolution of some formal institutions influenced the incentive structures of SHFs (Chapter 2). Specifically, the influence of changes in (1) the organization that sets cocoa producer prices in the internal market, and (2) the price-setting rules applied to producer price, and their stability. Ghanaian cocoa farmers respond positively to producer prices in terms of supply (Abdulai and Reider, 1995; Gyimah-Brempong, 1987). However, we also found that the variation or instability of producer prices has a negative impact on their production activities, because it creates uncertainty and distorts expectations (Chapter 2).

Shifting the price formation responsibility from COCOBOD to a multi-stakeholder platform (the producer price review committee or PPRC) brought greater transparency in the price-setting process (Chapter 2). The PPRC made the rules of

price determination more flexible. Producer pricing was no longer based on a rigid cost-plus-margin estimate, but on a negotiated percentage of the export price, after a number of industry (or chain-upgrading) costs were deducted. With more transparency and a flexible pricing rule, producers could negotiate for higher prices. This institutional change led to a significant increase in the share of the world price transmitted to producers. Nevertheless, with these changes came negative consequences. One was that, by following the fluctuations of the world price, the producer price stabilization objective of COCOBOD had been compromised.

Combined with the earlier finding that farmers tend to reduce their supply when prices become more variable (unstable), these results paint a picture of how institutions can put farmers at risk and constrain their opportunities to improve their production activities (Hounkonnou et al., 2012; Röling et al., 2012). It also shows that if carefully managed, price-setting institutions have the ability to enhance producer incentives.

Formal and informal institutions shape SHFs' incentive to enhance cocoa bean quality

A crucial question in a number of publications is: what will motivate SHFs to increase the production of quality cocoa beans? (Osei, 2007; Laven, 2010; Williams, 2010; Hainmuller, 2011). While different stakeholders define quality cocoa beans differently, much emphasis is placed on physical characteristics, such as moisture content, colour (an indication of fermentation), pest infestation, and uniformity of size. Consequently, two quality grades exist in Ghana, based on the percentage of physical defects: a high standard Grade I and a lower quality Grade II. Yet, SHFs are not always able to produce cocoa that meets Grade I standards.

Often farmers are unable or unwilling to invest resources into recommended quality-enhancing recommendations because there are little or no incentives to do so. Consistent with the literature, this study has provided evidence to show that a number of institutional factors, which are often beyond farmers' control, explain this behaviour pattern. Farmers' inability to invest in quality-enhancing technology arises due to inadequate knowledge. Contacts of farmers with extension workers have been very limited due to the fact that for over two decades since 1984 extension policies stopped focusing on cocoa commodity development. Hence the specialized cocoa extension services unit of COCOBOD was merged with the Ministry of Agriculture. With lack of special emphasis on cocoa, farmer-extension worker contact hours gradually declined considerably. The consequence of this inconsistent extension policy is that farmers' knowledge of appropriate quality-enhancing technologies is generally inadequate (Dormon, 2006). Therefore, they often do not produce beyond Grade II.

Farmers' unwillingness to enhance the quality of their cocoa beans any further also arises from informal institutional factors like land tenure contracts, corruption and rent-seeking behaviour of cocoa buyers, affecting farmers' income position negatively. Farmers do not have enough countervailing power to deal with these problems because they are often very weakly organized (Chapter 3).

The willingness of farmers to enhance the quality of their produce is also influenced by an asymmetric information problem (Akerlof, 1970; Stiglitz, 1975). This problem arises because buyers do not determine the quality features of the produce before or even after sale transaction. This asymmetric information is attributed to the lack of market governance arrangements that ensure that cocoa beans are graded before purchase from farmers. The absence of grading before purchase and the subsequent payment of uniform prices lowers producer incentives to enhance quality, because raising quality through additional effort is not rewarded (Quarmine et al., 2012). In the absence of a pay-for-quality policy, and given their low incomes, farmers will rather not invest extra labour in further enhancing produce quality.

7.2.2 Experimentation with alternative solutions

These identified problems work to weaken Ghana's position on the world market as a supplier of premium quality cocoa beans. How can policy makers and other actors in the cocoa sector of Ghana ensure that farmers enhance the quality of their produce? There are opportunities to change institutions to structure farmer incentives: 1) change farmer knowledge institutions by re-organizing extension services; 2) reconsider market governance structures. Below, three empirical experiments (Chapters 4, 5 and 6) which sought to test how alternative market governance arrangements can structure SHFs incentives to enhance the quality of their produce are discussed.

Farmer knowledge institutions do not provide sufficient incentives for SHFs to enhance produce quality

Inconsistent extension policy negatively affected farmers' knowledge about quality-enhancing technology and hence their capacity to enhance the quality of their produce (Chapter 3). The literature demonstrates a positive relationship between participatory methods of innovation development and farmer knowledge (Biggs, 2007; De Jager et al., 2004; Ton, 2005). Although the impact of participatory methods on yield-enhancing technologies has been studied (Ayenor et al 2007, Soniia and Asamoh, 2011), the question is whether SHFs will continue to use the technologies they learned after having been involved in the participatory studies. For example, a significant rationale of the COS-SIS research program, within which framework this thesis is written, is that while participatory methods could make considerable impact locally,

the continuous adoption of the technology often depends on institutional conditions over which farmers have no control (Van Huis et al, 2007).

This hypothesis was tested by comparing the early adoption behaviour of farmers who had been involved in participatory learning about quality enhancing-technologies with that of farmers who learnt about the same recommendations through much more linear conventional methods. It was found that participatory research methods improved farmer knowledge about cocoa production practices more than conventional extension. Their gain in knowledge did not motivate farmers to enhance cocoa bean quality as we would have expected. Instead, farmers in participatory learning selected more pre-harvest activities, which increased their yields at a relatively low cost (Chapter 3). Farmers' selective try-outs of post-harvest technologies on their own plots therefore only resulted in a moderate improvement in cocoa bean quality.

These results suggest that economic (income) considerations ("what is in it for me") are the dominant criterion for farmers when deciding on the quality of their produce. They challenge the argument of some social scientists that historical antecedents and other social forces such as reputation, knowledge and reciprocity norms among farmers are more important drivers of adoption of technology by farmers than market forces. Yet, the cocoa market is organized such that farmers who increase their yields benefit more, in terms of income, than those who spend resources on quality enhancement.

Does certification address the asymmetric information problem?

As long as the interaction between farmers and buyers is characterized by asymmetric information problems, producers will be reluctant to invest extra labour and capital into recommended quality-enhancing technologies (Chapter 3 and 4). Unfortunately, policy has failed to give this asymmetric information problem the relevant attention. Rather, broad policy instruments such as scholarships, bonuses and mass-spraying of all farms are implemented, which do little to address the main problem of asymmetric information.

Economists suggest two categories of market governance arrangements that can address the information problem. The first category of arrangements, which can be referred to as screening devices, assists cocoa buyers to sort farmers or their produce into different quality categories before and after trade transactions. One such mechanism is certification or labelling. In Ghana's cocoa sector, two market arrangements exist: the mainstream market and the certification market. While there is enough evidence of the impact of certification programs on cocoa in terms of yields, there is a lack of evidence about how certification programs address the problem of

asymmetric information (Afari-Sefa et al., 2010; Gockowski et al., 2013; Kleeman and Abdulai, 2012).

The study revealed that farmers in certification programs apply higher levels of effort to enhance the quality of their cocoa beans than independent farmers (Chapter 5). Holding other exogenous variables and input use constant, increased effort resulted in higher volumes of quality cocoa beans. Certification programs are able to elicit these high volumes of quality cocoa from farmers because their incentive mechanisms address the information asymmetry more directly. Specifically, mechanisms of quality testing before purchase in combination with traceability afterwards have the most impact among the factors that reduce the information problem. These mechanisms work effectively because of the strict enforcement of punishment and rewards by the producer organization under which umbrella certification operates.

These findings are consistent with the suggestion of Laven and Boomsma (2012) that certification can be used as a tool for meeting the growing demand for sustainable cocoa beans across the world. Already, policy makers are discussing possibilities of achieving the 2015 cocoa production certification standards stipulated by the World Cocoa Foundation.[1] Direct market governance structures are sufficient conditions for motivating SHFs to supply higher quality produce.

The "carrot and stick" approach to pricing addresses the asymmetric information problem

The second category of governance arrangements, proposed by economists to address asymmetric information problems, encourages farmers to select themselves into different markets based on the quality of their beans. A typical self-selection device that has been discussed in the literature is price differentiation.

Even before Ghana's independence in 1957, the cocoa sector actors were discussing how to design price differentiation mechanisms to induce self-selection among farmers (Amoah, 1998). In 1953 the colonial administration introduced price differentiation in the cocoa market. The policy failed the following year after it was introduced because it did not have built-in mechanisms to address a number of problems. These problems included the costs associated with quality testing, lack of infrastructure, and conflict among the actors regarding what constituted cocoa bean quality. Overtime, the cocoa market has been reformed and several infrastructural bottlenecks have been removed. For instance, a uniform physical cocoa quality standard has been developed and accepted by farmers, buyer and policy makers over the years. Secondly, the road networks to cocoa-growing communities have been

[1] http://www.ghanaweb.com/GhanaHomePage/NewsArchive/artikel.php?ID=259970

extensively developed. Finally, the market reforms allowed competitive cocoa buying activities at farmgate.

Given these changes, then, will a price differentiation policy reduce the problem of asymmetric information? This issue was tested by building a "carrot and stick" mechanism into a price differentiation experiment. A "carrot and stick" mechanism combines rewards and punishments to shape people's choices. The "carrot and stick" mechanism we used, also referred to as test-cum-fee, worked as follows: A buyer offered his/her regular trade partners a price menu with two options. The first option was the regular market price for cocoa beans of any quality above the normal, minimum quality standard. In the other option, cocoa of better quality could be sold for a higher price (the "carrot") so long as it met a certain higher standard. Some other conditions were however required before the supplier of higher quality produce was paid. A farmer willing to sell cocoa for a higher price was to pay a fee (the "stick") to have his or her produce tested. If the produce met the high standard set by the buyer, the seller received the high price (which more than compensated for the fee), otherwise he or she just received the regular market price and the test fee would become his or her cost. Faced with this menu of prices, it was hypothesized that farmers would select themselves to enhance the quality of their produce.

This experiment, where farmers were exposed to price differentiation with such a test-cum-fee option, yielded two major outcomes. First, the overall quality of cocoa supplied per hectare in communities where price differentiation was introduced increased significantly compared to control communities (Chapter 6). Second, based on their risk preferences, their perceptions and understanding of the price differentiation mechanism, and their actual capacity to supply quality cocoa beans, SHFs exposed to test-cum-fee sorted out their better produce and sold it for a premium, while their average quality beans were traded for the regular price. Thus test-cum-fee mechanism resulted in significant self-selection behaviour among farmers.

Put together, these results meant that not only were SHFs better off in terms of income, but also the LBC they traded with would have to incur less costs to upgrade the purchased cocoa beans. In the long run, one can argue therefore that Ghana stands to benefit from such a policy when majority of farmers adapt their production decisions to take advantage of a market which offers them higher revenues for taking up some of the costs of upgrading.

7.3 Policy implications

A number of policy implications can be derived from the empirical evidence provided by this thesis. First, this study highlights the importance of formal and informal

institutions as determinants of farmers' capacity and willingness to enhance the production of quality cocoa beans. Different types of institutional factors have been identified in this study, particularly formal institutional factors such as rules, regulations, policies and enforcement organizations which shape farmer education and trading practices. Ghana's cocoa sector is strongly supported by such institutional factors. Specifically, the presence of a governing board, which seems to have a posture of introducing gradual reforms into the sector (Essegbey and Ofori-Gyamfi, 2012; Laven, 2010). When compared to other countries without such institutional support, it is seen that Ghana is better able to manage problems associated with producing and exporting quality cocoa beans (Amoah, 1998).

The cocoa literature devotes significant space to comparison of the impact of institutional settings in producing countries on the quality of produce. Ivory Coast, Ghana, and Nigeria are among the largest producers of the crop but have different institutional settings. Prior to economic liberalization policies across Africa in the 1980s, the governments of these countries controlled cocoa production and exports through marketing boards. Ghana and the rest of the African countries are a classic case of comparison because they took different approaches to liberalization of their cocoa sectors. While Ghana chose to maintain its central institutional structures and to introduce gradual reforms, Nigeria and Ivory Coast fully liberalized their cocoa sectors (Williams, 2009). As a result, whereas Ghana's cocoa production, pricing, quality assurance and export are centrally controlled by COCOBOD, Nigeria and Ivory Coast allowed private companies to drive the market. Laven et al. (2007) conclude that quality deteriorated completely in the case of the fully liberalized countries. This study's findings therefore reinforce policy debate for the need to maintain the core structure of the cocoa sector. Notwithstanding the strong institutional context of cocoa in Ghana, a number of issues related to supply of good quality cocoa beans by SHFs could be better addressed. For example, existing farmer knowledge systems can be improved (Chapter 4). On-going reforms in cocoa extension provide opportunities for policy makers to introduce more participatory methods of farmer education.

Even though smallholder farmers can further enhance the quality of their produce, the set of rules that govern the internal cocoa market of Ghana creates an asymmetric information problem which constrains them from doing so. Attention needs to be placed on designing governance structures that coordinate farmers to enhance the quality of their produce by directly rewarding or costing them for their performance. Following the positive impact of certification on SHFs incentive to enhance the quality of their produce (Chapter 5), it is recommended that COCOBOD policy should create the space for the growth of certification programs in Ghana. This recommendation is in line with COCOBOD's target to fully certify its cocoa by 2015.

The opportunity to expand certification already exists. For instance, an internal certification program is already operational where all cocoa beans shopped from Ghana are inspected and certified as being of premium quality by the Quality Control Company Limited. What is lacking in this system however is that cocoa beans cannot be traced back to the farm where it was produced.

Policy makers need to continue deliberations on the best possible means to ensure the market is fully certified with traceability systems. One way to achieve this is to create an environment for FBOs to thrive. Certification thrives with well-developed producer organizations (Jena et al., 2012). With a worldwide increased demand for certified cocoa beans, there is the temptation for policy makers to hasten this process of certifying all cocoa producers. This thesis however provides evidence that not all farmers are willing or able to participate in certification programs (Chapter 5). Hence the process of certifying Ghanaian cocoa should be approached with care (Laven and Boomsma, 2012). Policy makers can learn from history. Between 1930 and 1970 the government created laws to put all farmers into one cooperative organization and controlled their activities (Acquaah, 1999; Cazzuffi and Moradi, 2010; Young et al., 1981). This approach did not help to develop farmers' managerial ability and capacity to organize. In the long run, poor organization, lack of trust and mismanagement among cocoa cooperatives led to the complete breakdown of producer associations and put the entire sector at risk.

There is a need for policy makers to be open to ideas which seek the best pricing mechanism which will aid in maintaining Ghana's premium cocoa position on the world market. The implication is that minimum price floors for all quality grades cannot provide enough push for farmers to enhance the quality of their produce. Hence, in line with suggestions from some sections of the cocoa literature, it is recommended that policy makers consider quality price differentials at farmgate (Barrientos et al., 2007; Leiter and Harding, 2004). This study shows that an alternative pricing strategy with a test-cum-fee mechanism will adequately reward farmers who supply higher quality produce and so significantly address asymmetric information problems in Ghana's cocoa sector.

A critical look at Ghana's cocoa market regulations is required in order to identify specific legal and policy instruments that can be formulated to create the room for price differentiation. When Ghana partially liberalized its internal cocoa market in 1992, and allowed for private firms to participate as first buyers of the produce, it was hoped that that these firms would compete on prices and as such design new pricing mechanisms to address asymmetric information. Why did LBCs not compete on prices? One school of thought is that the margins within which they operated were too limited. Cocoa regulations make it difficult for LBCs to sell cocoa externally; hence

they have to operate within the narrow margins set for them by COCOBOD. After over two decades of liberalization of the internal cocoa market, the time may just be right to critically review the marketing practices of LBCs and the legal regulations within which they operate in order to identify important reforms needed to provide direct incentives to farmers to enhance the production of quality cocoa beans.

7.4 Limitations and recommendations for future research

The outcome of the investigations presented in this thesis revealed a number of limitations that may be addressed in future research activities which seek to find mechanisms to motivate farmers to enhance the quality of their produce. These limitations relate to the approach adopted for the entire study, design issues and some institutional factors not addressed in this thesis.

7.4.1 Reflection on the CoS-SIS approach to research

Focus on institutions

The five empirical studies which comprise this thesis were conducted within the framework of the CoS-SIS research program. This explains why we employed institutional perspectives to investigate how farmers can be motivated to increase the quality of their produce. Institutions have been widely accepted in development economics as important determinants of agricultural development. However institutions encompass a complicated set of factors which have not been fully unbundled in the literature or in this thesis. There is on-going debate regarding whether institutions can change in the short-run. If they can, there is no clear understanding how (Voors, 2012).

It was found that some institutional factors can be deliberately altered in the short-run which can create incentives for agricultural producers. Such institutions include mechanisms that govern trade relationships between farmers and LBCs. However, the windows of opportunities created by institutions which can be altered in the short-run are often narrowed by other institutional factors which are difficult to change even in the long run (such as land tenure). Furthermore, institutional change often requires activities such as advocacy, negotiation, and facilitation of interactions that are beyond the time and budget scope of a PhD researcher. Therefore, his or her best contribution is to provide empirical evidence to feed the negotiation process of institutional change.

Diagnostic studies

A flagship component of the COS-SIS approach to research is that the research process begins with a diagnostic study. The diagnostic studies unearthed often

neglected but relevant institutional issues that plague the cocoa sector. The diagnostic studies enriched other empirical studies because their findings encompassed the opinions and expectations of all stakeholders. However, a number of bottlenecks arose during this phase of the research. Chiefly, it was difficult to obtain information on sensitive issues like cocoa bean quality at the various stages of the value chain. Faced with this challenge and the general knowledge that Ghana exports only premium quality cocoa, it became almost impossible to make claims about quality at farmgate. However, with continuous critical reflection and interaction with stakeholders, the issues became clear. The implication is that future PhD researchers can identify relevant research issues that benefit smallholder farmers through diagnostic studies and regular interaction of stakeholders.

Experimental design and CIGs

In line with the CoS-SIS research process, the specific empirical research work presented in this thesis was agreed upon after several discussions with stakeholders. One observation during these discussions was that the cocoa sector is made up of a number of stakeholders with entrenched interests. For instance, while farmers were open and expectant to experimentation with alternative governance structures, policy makers were critical of such an approach. They argued that any alternative structure may be counterproductive to the cocoa sector. They cited previous experimentation with such policies and how these collapsed because they did not suit well the Ghanaian conditions. Furthermore, policymakers mentioned that Ghana receives a premium for *all* quality grades in the world market; hence it cannot differentiate prices in the domestic scene. Finally, some policy makers were of the opinion that compared to other countries, Ghana had the best governance structure for exporting quality cocoa beans, hence there was no need for reforms. Such conflicting expectations put a researcher in a position where he or she must take several roles, including the facilitation of interactions and negotiations.

These observations may have prompted the design of the COS-SIS program to initiate an innovation platform called Concertation and Innovation Group (CIG), where motivated actors team up to facilitate institutional change. The cocoa CIG worked on transparency of cocoa pricing. Hence some of the empirical observations in the thesis formed an input of the work of the CIG (Adu-Acheampong, 2012). For instance, having observed that the market institutions were important to structure producer incentives (Chapter 2 and 3), the CIG developed the objective of influencing the cocoa price-setting process. Another objective of the CIG, partly informed by the studies on farmer participatory research and learning (Chapter 4), was to improve the cocoa mass spraying policy. The interest of the CIG over the study period did not

always align with the empirical studies agreed upon with stakeholders involved in the diagnostic study. The CIG did not prioritize differentiated prices for farmers, but instead chose to promote higher prices for cocoa farmers than their colleagues in neighbouring countries.

7.4.2 Recommendation for future research

Even though diagnostic studies (Chapter 2 and 3) revealed both formal and informal institutions as the main impediments to farmers in their effort to enhance the quality of their produce, the empirical studies reported in this thesis do not address them all. The extent to which (in) formal institutional factors like trust, land tenure contracts, informal networks and alleged corrupt practices of LBCs can be changed, and how these changes will provide incentives for producers to supply better quality cocoa remains to be studied. While studies such as Nakane (2000) and Baah (2011) attempt to investigate incentives embedded in informal institutions, they fail to explain how informal institutions shape farmers' decision to enhance the quality of their produce.

The time frame of the study on farmer participatory research (Chapter 4) in which adoption was measured, may have been too short for farmers to fully decide to adopt quality-enhancing practices. The analyses presented, while still relevant, would have been richer if participatory training activities occurred over a longer period and farmers had adequate time to decide on whether to adopt these practices or not. An essential area of future research will thus be to assess whether there are long-term differences in the adoption behaviour of farmers exposed to participatory research and other extension delivery methods.

A number of methodological issues also emerged from this thesis. A certification program that pays a price premium directly to farmers was investigated. However, more insights are needed to understand alternative certification programs like fair-trade, which pay a social premium to the collective of farmers. In this study on certification, effort scores generated by estimating an index of farm activities and the frequency or time spent on these activities. Future research may explore additional means of determining how much effort farmers put in their farm activities. The certification program we studied, like many others, thrive on well-organized FBOs. Previously, we proposed that COCOBOD's agenda of certifying cocoa produced from Ghana will more likely succeed if it is linked with well-developed producer organizations. In recent years, some studies have been conducted on cocoa FBOs in Ghana (Baah, 2008). However, more theoretical and empirical work on how FBOs emerge and how their organization is influenced by the institutional context is required. There is a need for further research also on how the organization of FBOs

provides incentives for their members to enhance the production of quality cocoa beans.

This thesis also presented outcomes of an experiment where farmers (exposed farmers) were offered a menu of prices, and their behavioural response was compared to those of control farmers (who faced just one price for all grades) (Chapter 6). This experiment was limited in a number of ways. First, there is the question of external validity. The experiment was carried out in the Suhum cocoa district in the Eastern region of Ghana, where agro-ecological conditions are quite different from other regions in the cocoa belt of Ghana. Factors like rainfall and sunshine days may have influenced the quality of cocoa beans produced. Second, the limited number of treated (60) and control (40) farmers restrict the inferences we could have drawn from the experimentation. Future research which compares different price differentiation mechanisms across different districts and years is recommended. Third, even though our experimental price premium and test fees were informed by research and practical considerations, alternative combinations of price premium and fee need to be tested in future studies in order to find the optimal combination which might inform policy and LBC purchasing practice. Finally, we showed evidence that LBC upgrading costs may decline with the introduction of price differentiation with a test-cum-fee mechanism. Yet, the cost structures of LBCs were not thoroughly discussed. More empirical evidence on how institutions shape the costs and governance structures of LBCs and what prevents them from competing over prices remains to be done.

7.5 Concluding remarks

Empirical evidence has been presented to show, among other things, that if smallholder farmers in Ghana adopt more recommended technologies, the volume of quality cocoa beans produced will increase. Drawing from institutional perspectives, this thesis has demonstrated that the set of rules that govern the cocoa market in Ghana limits the incentives for smallholder farmers to further enhance the quality of their produce. Two alternative governance structures which may provide beneficial win-win solutions to the existing asymmetric information problem were proposed. These were certification through FBOs with a built-in mechanism of traceability and price differentiation with test-cum-fee options. The posture of policy makers towards gradual reforms in the cocoa sector may create an opportunity to further examine alternative governance structures related to quantity and quality of cocoa produced in Ghana, in order to make the country even more competitive on the world market.

Summary

Cocoa beans from Ghana have a reputation of being of consistent quality. As such they sell at a premium on the international market. As a result of this quality reputation, Ghana is able to sell over 70% of its annual produce in forward markets. This trading practice ensures that farmers are protected from price fluctuation in the international market. Consequently, farmers, buyers, scientists and policy makers agree that sustaining Ghana's premium quality position on the international market should be a central component of cocoa sector policies in Ghana.

Over the years, therefore, policy and programme attention has been placed on ensuring that the produce supplied by farmers is of superior quality. Some of these efforts have included development of clearer quality parameters, establishment of cooperative societies, market liberalization, introduction of competition in the cocoa market, and farmer extension reforms among others. In spite of the attention paid to quality, evidence is emerging that farmers can do more to enhance the quality of their produce. For example, nationwide, disease infestation alone results in loss of up to 35% of the potential crop. Also, the surge in poorly fermented and not thoroughly dried produce has been amply described in the literature. These quality issues would not arise if farmers were to improve their rate of adoption of the several recommended quality-enhancing technologies developed by scientists.

The question is therefore frequently asked: why does the rate of adoption of recommended technologies by farmers fall below the expectation of policy makers and scientists? Drawing mainly from new institutional economics, this thesis argues that the adoption by farmers of quality-enhancing technologies is hampered by the rules (or institutions) that govern interactions in the internal cocoa market of Ghana. The central object of this thesis is to gain an insight into what institutional factors are and how they can be altered to provide effective incentives for Ghanaian cocoa farmers to enhance the production of quality cocoa beans. Five specific objectives were addressed. First, impact of specific price-related institutional reforms on producer incentives was analysed. Second, the study identified relevant institutional factors constraining smallholders from enhancing the production of quality cocoa beans. These two studies set the stage for experimentation with alternative institutional mechanisms which might motivate cocoa farmers to enhance the quality of their produce. Hence, the third objective explored agricultural knowledge institutions by comparing the effectiveness of participatory and conventional extension methods on accumulation of knowledge and adoption of quality-enhancing technologies. The fourth and fifth objective of this study then focused on what alternative institutions may be designed to govern cocoa beans trade to ensure that Ghana sustains its good

premium quality reputation. The fourth objective of this study assessed the influence of incentive mechanisms designed by certification programs on farmers' effort to enhance the quality of cocoa beans they produce. The fifth objective then attempted to determine the extent to which farmers respond to a price differentiation structure which builds in mechanisms of rewards and punishments.

Having introduced the thesis in the first chapter, **Chapter 2** addressed three questions: (1) did prices and the variation of these prices influence cocoa supply?; (2) to what extent did institutional reforms affect the stability of producer prices? and (3) how did cocoa price-related institutional reforms affect the transmission of world price to producers? A time series econometrics approach was employed in this study. To assess the impact of prices on farmer behaviour, a double-logarithmic ordinary least squares (OLS) regression was estimated. Cocoa production was regressed on current and lagged producer prices and on a number of control variables, including the price of maize. To answer the question of how cocoa price-related institutional reforms affected the transmission of world price to producers, specific reform eras were first identified. These were: (1) before and after the introduction of the Producer Price Review Committee (PPRC); and (2) before the use of cost-plus-margin price rule; during the cost-plus-margin price rule; and during the percentage F.O.B. pricing rule. Next, a co-integration and error correction approach was employed to analyse the impact of these reform periods on the transmission of world prices to producers. The results confirmed economic theory in that increases in the producer price provided sufficient incentives for farmers to increase their output while the variation or instability of this price was a disincentive. The institutional reforms led to increases in prices but did little to stabilize producer prices over the years. These results pointed to the important role institutions can play in shaping farmer incentives.

The time series data employed in the analyses of institutions failed to account for the perspectives of stakeholders. **Chapter 3** therefore employed a cross-sectional approach to investigating how institutions shape the incentive for smallholders to enhance the quality of their produce. A number of formal and informal institutions work together to constrain farmers' capacity and willingness to enhance the production of quality cocoa beans. Farmer knowledge institutions, especially the organization of cocoa extension, have resulted in low contact hours between farmers and extension agents. This affected the knowledge and hence capacity of farmers to utilize relevant technological innovations which could enhance the quality of their produce. Farmers' unwillingness to enhance the quality of their cocoa beans any further also arises from institutional factors like land tenure contracts, corruption, and rent-seeking behaviour of cocoa buyers, which affect their income position. Farmers do not have enough countervailing power to deal with these problems because they are often very weakly

organized. The willingness of farmers to enhance the quality of their produce is also influenced by an asymmetric information problem. This problem arises because buyers do not determine the quality features of the produce before or even after sale transaction. This asymmetric information is attributed to the lack of market governance structures that ensure that cocoa beans are graded before purchase from farmers. The absence of grading before purchase results in payment of uniform prices for all quality grades. In the absence of a pay-for-quality policy farmers will rather not invest extra labour in further enhancing produce quality.

In Chapter 4, the effectiveness of participatory and conventional extension methods of extension on accumulation of knowledge and adoption of quality-enhancing technologies was compared. Farmers involved in participatory research were compared with those involved in conventional extension in terms of knowledge accumulation, yields and bean quality. It was found that using recommended technologies can enhance the cocoa bean quality 17% more than current practices. At a cocoa price of US$ 1.86 per kilogramme, profits per hectare were with recommended technologies about 8% higher than with farmers' practices, just because recommended technologies yielded higher volumes of cocoa. If cocoa prices at the farm gate would be differentiated by quality, the relative profitability of using good agricultural practices would even be higher. Being trained through participatory methods resulted in significant improvement in farmers' knowledge. Their gain in knowledge did not motivate farmers to enhance cocoa bean quality, but rather farmers selected specific yield-enhancing technologies for adoption. This chapter confirmed that as long as there is a lack of market incentives farmers are unwilling to adopt quality-enhancing recommended technologies.

In Chapter 5, the question of how certification programs influence farmers to enhance the production of quality cocoa beans was addressed. The study identified the determinants of the choice between being an independent farmer and being a certified farmer. The study showed that farmers with a high marginal utility of income participated in certification. Furthermore, farmers that for some reason were constrained in their capacity to apply extra effort to their pre-harvest and post-harvest activities, by lack of time or health conditions, were not likely to join the certification program. Having joined certification programs a number of incentive mechanisms were used to coordinate farmers' production activities to ensure they supply quality cocoa beans. First, certification programs organize farmers into producer organizations which use their internal rules of rewards and punishments to strictly enforce quality requirements. Also, certification programs employ traceability mechanisms where every cocoa bean can be traced to the farm where it was produced. Hence the information asymmetric problem is completely resolved. Additionally certification

programs pay a higher price for the quality of produce they purchase. These mechanisms were not available to independent farmers. As a result of these differences in trading practices and incentive mechanisms, certified farmers put up 17% more pre-harvest and 20% more post-harvest effort in their production practices than independent members. This explains why certified farmers recorded 52% higher yields and 12% better quality than independent farmers.

In Chapter 6 an alternative market governance mechanism to certification was experimented with. The impact of price differentiation with self-selection was tested by offering farmers in the Suhum district a menu of price; the regular producer price for lower quality Grade II cocoa beans and the higher price for Grade I cocoa. To receive the higher price however farmers were to pay a fee (of 1kg of cocoa beans) and had to have their beans tested. If the produce met the high standard set by the buyer, the seller received the high price (which is equivalent to 3kg of cocoa), otherwise he or she just received the regular market price and the test fee would become his or her cost. The results showed that faced with this menu, farmers exposed to this test-cum-fee price option significantly improved the quality of their cocoa beans by 2.7% more than control farmers. Other factors which significantly impacted on the quality of farmers' produce were previous involvement in farmer participatory research (Chapter 4) and dependence on cocoa as a main source of livelihood. A central aim of test-cum-fee price mechanism is to stimulate farmers to supply only their best quality produce. Over the two seasons of the experiment farmers who were exposed to the test-cum-fee price mechanism increased the proportion of their produce which was sold for a premium by 28%. The quality of these beans sold for a premium also improved over the experimental period by 3%. This self-selection behaviour is explained by farmers' risk preferences, perception about the new price mechanisms, and their capacity to enhance their quality of their cocoa beans.

In Chapter 7, the main findings of the study were summarised and their policy implications were discussed. The study's limitations were highlighted and some ideas for future research were proposed. Problems with cocoa bean quality at farmgate have been attributed to asymmetric information between farmers and buyers. As a result of this information problem, buyers are unwilling to pay for quality. This thesis puts forward two governance structures which can address the asymmetric information problem. First, it is demonstrated that certification of producer organizations with mechanisms of traceability, group control and price premiums can completely resolve the information problem. This thesis shows that another governance structure with a win-win potential to address the information problems in Ghana's cocoa industry is price differentiation with self-selection mechanisms. Policy makers therefore need to

pay closer attention to these mechanisms if Ghana is to sustain her position as a net supplier of premium quality cocoa beans.

Samenvatting

Cacaobonen uit Ghana hebben de reputatie van constante kwaliteit te zijn. Op de internationale markt verkopen ze derhalve tegen een meerprijs. Dankzij deze reputatie is Ghana in staat meer dan 70% van de jaarlijkse productie op termijnmarkten te verkopen. Dit zorgt ervoor dat boeren beschermd zijn tegen internationale prijsfluctuaties. Boeren, kopers, wetenschappers en beleidsmakers zijn het er daarom over eens dat het behoud van Ghana's positie als internationale aanbieder van cacao van hoge kwaliteit een centraal onderdeel van het beleid met betrekking tot de cacaosector in Ghana zou moeten zijn.

Om deze reden is binnen beleid en programma's jarenlang de aandacht uitgegaan naar het veiligstellen van de hoge kwaliteit van de opbrengst die door boeren werd aangeleverd. Hieronder vielen onder andere de ontwikkeling van duidelijkere kwaliteitsparameters, het oprichten van coöperaties, liberalisering van de markt, het stimuleren van concurrentie op de cacaomarkt en hervormingen van de voorlichting aan boeren. Ondanks die aandacht zijn er aanwijzingen dat boeren meer kunnen doen om de kwaliteit van hun product te verbeteren. Op landelijk niveau zorgt bijvoorbeeld alleen al infestatie voor een verlies van tot wel 35% van de potentiële oogst. Ook de toename van slecht gefermenteerde en niet volledig gedroogde producten is uitvoerig beschreven in de literatuur. Deze problemen zouden zich in mindere mate voordoen als boeren meer gebruik zouden maken van de kwaliteitsverhogende technologieën die door wetenschappers zijn ontwikkeld.

De vraag waarom boeren deze aanbevolen technologieën in mindere mate overnemen dan beleidsmakers en wetenschappers verwachten, is reeds vaak gesteld. Gebruikmakend van met name de nieuwe institutionele economie (NIE), wordt in dit proefschrift betoogd dat de adoptie van kwaliteitsverhogende technologieën door boeren wordt belemmerd door de regels (instituties) die de interacties op de binnenlandse Ghanese cacaomarkt reguleren. Het belangrijkste doel van dit proefschrift is inzicht te verkrijgen in welke deze instituties zijn en hoe deze veranderd kunnen worden zodat ze effectieve prikkels genereren die Ghanese cacaoboeren stimuleren de productie van kwalitatief hoogstaande cacaobonen te verhogen. Vijf specifieke kwesties kwamen aan de orde. In de eerste plaats werd de impact van specifieke, prijs gerelateerde institutionele hervormingen in Ghana op producentenprikkels geanalyseerd. Vervolgens werden enkele institutionele factoren geïdentificeerd die kleine boeren belemmeren bij het verbeteren van de kwaliteit van hun cacaobonen. Deze twee studies bereidden de weg voor het experimenteren met alternatieve institutionele mechanismen die cacaoboeren mogelijkerwijs motiveren om de kwaliteit van hun productie te verhogen. De derde studie verkende bestaande

instituties op het gebied van landbouwkennis door de effectiviteit van participatieve en conventionele voorlichtingsmethodes te vergelijken met betrekking tot de vermeerdering van kennis en het gebruik van kwaliteitsverhogende technologieën. De laatste twee studies richtten zich vervolgens op de vraag welke alternatieve instituties voor het beheer van de handel in cacaobonen kunnen worden ontworpen om het behoud van de reputatie van Ghana als producent van kwalitatief hoogstaande cacao veilig te stellen. De vierde studie trachtte vast te stellen wat de invloed is van de economische prikkels verbonden aan certificeringsprogramma's op de inspanning van boeren om de kwaliteit van hun cacaobonen te verhogen. De vijfde studie probeerde te bepalen in hoeverre boeren reageren op een structuur met prijsdifferentiatie en zelfselectie.

Na de introductie van de thesis in het eerste hoofdstuk, werden in **hoofdstuk 2** drie vragen aan de orde gesteld: (1) Hebben de producentenprijzen en de variatie hiervan het aanbod van cacao beïnvloed? (2) In hoeverre hebben de institutionele hervormingen de stabiliteit van producentenprijzen beïnvloed? En (3) hoe hebben de aan de cacaoprijs gerelateerde institutionele hervormingen de doorberekening van wereldprijzen aan producenten beïnvloed? In deze studie werd een econometrische benaderingswijze gebruikt. Om de invloed van prijzen op het aanbodgedrag van boeren te bepalen, werd een kleinste-kwadraten schatting (OLS) gemaakt. Cacao productie werd geregresseerd op lopende en vertraagde producentenprijzen en op een aantal controlevariabelen, waaronder de prijs van maïs. Om een antwoord te vinden op de vraag hoe de aan de cacaoprijs gerelateerde institutionele hervormingen de overdracht van wereldprijzen op producenten hebben beïnvloed, werden eerst een aantal specifieke hervormingsperioden geïdentificeerd. Dit waren: (1) vóór en ná de invoering van de Producer Price Review Committee (PPRC); en (2) vóór het gebruik van de kosten-plus-marge waarderingsregel, tijdens het gebruik van de kosten-plus-marge waarderingsregel, en tijdens de z.g. percentage-F.O.B. waarderingsregel. Vervolgens werd een co-integration en foutencorrectie procedure gebruikt om de impact van deze hervormingsperiodes te bepalen op de transmissie van wereldprijzen naar producentenprijzen. De resultaten bevestigden de economische theorie: een stijging van de producentenprijs was voldoende stimulans voor boeren om hun productie te vergroten, terwijl meer variatie of instabiliteit van deze prijs ontmoedigend werkte. De institutionele hervormingen leidden tot prijsstijgingen maar hielpen nauwelijks bij het stabiliseren van producentenprijzen met de jaren. Deze resultaten wijzen op de belangrijke rol die instituties kunnen spelen bij het creëren van prikkels voor boeren.

De data tijdreeksen die gebruikt werden bij de analyses van de institutionele hervormingen konden geen licht werpen op de perspectieven van *stakeholders*. In

hoofdstuk 3 werd daarom een *cross*-sectie aanpak gebruikt om te onderzoeken hoe instituties kleine boeren stimuleren om de kwaliteit van hun productie te verbeteren. Een aantal formele en informele instituties beïnvloeden gezamenlijk het vermogen en de bereidwilligheid van boeren om de productie van goede kwaliteit cacaobonen te verhogen. Instituties op het gebied van landbouwkennis, met name de manier waarop voorlichting aan cacaoboeren is georganiseerd, hebben het aantal contacturen tussen boeren en voorlichters verkleind. Dit had effect op de kennis en daardoor het vermogen van boeren om relevante technologische innovaties te gebruiken die de kwaliteit van hun opbrengst zouden kunnen verbeteren. De onwilligheid van boeren om de kwaliteit van hun cacaobonen verder te verbeteren, komt verder voort uit institutionele factoren die hun inkomenspositie nadelig beïnvloeden, zoals contracten met betrekking tot de pacht van land, corruptie, en winst zoekend gedrag van cacaokopers. Boeren zijn niet opgewassen tegen deze problemen omdat zij vaak nauwelijks georganiseerd zijn. De bereidheid van boeren om de kwaliteit van hun productie te vergroten wordt ook beïnvloed door een asymmetrische informatievoorziening. Dit probleem doet zich voor omdat kopers de kwaliteit van de cacao niet testen, zelfs niet na de verkooptransactie. Deze asymmetrische informatie is toe te schrijven aan het gebrek aan beheersstructuren die garanderen dat cacaobonen worden geclassificeerd vóórdat ze gekocht worden van boeren. De afwezigheid van sortering voor koop resulteert in de betaling van een uniforme prijs voor alle kwaliteiten. Zonder een beleid gericht op betaling naar kwaliteit zullen boeren geen extra arbeid willen investeren in het verder verbeteren van de kwaliteit van hun product.

In **hoofdstuk 4** werd de effectiviteit van participatieve en conventionele voorlichtingsmethodes op de vermeerdering van kennis en de adoptie van kwaliteitsverhogende technologieën vergeleken. Boeren die betrokken waren bij de participatieve methode werden vergeleken met boeren die deelnamen aan conventionele voorlichting met betrekking tot kennisvermeerdering en opbrengst en kwaliteit van cacaobonen. Hierbij bleek dat het gebruik van aangeraden technologieën de kwaliteit van de cacaoboon 17 % meer kan verhogen dan gangbare praktijken. Bij een cacaoprijs van 1.86 US$ per kilo waren de winsten per hectare met aangeraden technologieën ca. 8 % hoger dan gebruikelijk, alleen al omdat de aangeraden technologieën grotere volumes cacao opleverden. Als producentenprijzen van cacao naar kwaliteit gedifferentieerd zouden worden, zou de relatieve winstgevendheid van het gebruik van z.g. goede landbouwmethodes (Good Agricultural Practices) nog hoger zijn. Training middels participatieve methodes resulteerde in een significante verbetering van de kennis van de boeren. Deze kennistoename motiveerde boeren echter niet om de kwaliteit van de cacaobonen te verbeteren. In plaats daarvan

selecteerden de boeren specifieke opbrengstverhogende technologieën. Dit hoofdstuk bevestigde dat zo lang marktprikkels zoals prijsdifferentiatie ontbreken, boeren niet bereid zijn om technologieën te gebruiken die de kwaliteit verhogen.

In **hoofdstuk 5** werd de vraag hoe certificeringsprogramma's boeren aanzetten om de productie van cacaobonen van goede kwaliteit te vergroten, aan de orde gesteld. Het onderzoek identificeerde de determinanten die bepalend zijn voor de keuze van boeren om onafhankelijk te zijn of zich aan te sluiten bij een certificeringsprogramma. Uit het onderzoek bleek dat boeren met een hoog marginaal nut van inkomen deelnamen aan certificering. Verder bleek dat boeren die moeilijk hun pre- en post-oogst activiteiten konden uitbreiden, door gebrek aan tijd of vanwege hun gezondheid, waarschijnlijk niet zouden deelnemen aan certificering. Boeren die bij een certificeringsprogramma zijn aangesloten, worden onderworpen aan een aantal economische prikkels teneinde hun productieactiviteiten te coördineren en om ervoor te zorgen dat zij cacaobonen van goede kwaliteit leveren. In de eerste plaats groeperen certificeringsprogramma's boeren in producentenorganisaties, die door middel van interne mechanismen van beloning en boete het naleven van kwaliteitseisen afdwingen. Verder gebruiken deze programma's opspoorbaarheidsmechanismen, die het mogelijk maken elke cacaoboon terug te voeren naar de boerderij waar hij geproduceerd is. Hierdoor wordt het asymmetrische informatie-probleem geheel opgelost. Certificeringsprogramma's betalen bovendien een hogere prijs voor de kwaliteit die zij aankopen. Al deze mechanismen waren niet beschikbaar voor onafhankelijke boeren. Door deze verschillen in handelspraktijk en prikkels staken gecertificeerde boeren 17 % meer energie in hun pre-oogst en en 20 % meer energie in hun post-oogst activiteiten dan onafhankelijke leden. Dit verklaart waarom gecertificeerde boeren een 52% hogere opbrengst en 12 % betere kwaliteit dan onafhankelijke boeren bereikten.

In **hoofdstuk 6** werd geëxperimenteerd met een marktbeheersstructuur die een alternatief bood voor certificering. De impact van prijsdifferentiatie met zelfselectie werd getest door boeren in het Suhum district een menu van prijzen aan te bieden: de reguliere producentenprijs voor tweede klas cacaobonen van lagere kwaliteit en een hogere prijs voor eerste klas cacao. Om de hogere prijs te ontvangen moesten de boeren echter een vergoeding (van 1 kilo cacaobonen) betalen en hun bonen laten testen. Als het product aan de hogere eisen van de koper voldeed, kreeg de verkoper de hogere prijs (die gelijk staat aan 3 kilo cacaobonen meer). Zo niet, dan ontving hij of zij de reguliere marktprijs en was de testvergoeding voor eigen rekening van de boer. De resultaten van dit onderzoek lieten zien dat boeren die geconfronteerd werden met dit menu de kwaliteit van hun cacaobonen significant (met 3 %) verbeterden ten opzichte van de controlegroep. Andere factoren die een significante invloed hadden op

de kwaliteit van de productie waren eerdere deelname aan participatief onderzoek (hoofdstuk 4) en de afhankelijkheid van cacao als belangrijke inkomstenbron. Een centrale doelstelling van dit *test-cum-fee* waarderingsmechanisme is boeren te stimuleren alleen cacao van de beste kwaliteit aan te leveren. Over twee seizoenen bezien, vergrootten boeren die onderworpen werden aan het test-cum-fee mechanisme de proportie van hun productie die voor een meerprijs verkocht werd met 28%. De kwaliteit van de bonen die een toeslag opleverden verbeterde bovendien tijdens de duur van het experiment met 3%. Dit zelfselectiegedrag kan worden verklaard door de risicovoorkeuren van boeren, de perceptie van boeren van de nieuwe prijsmechanismen en het vermogen van hen om de kwaliteit van hun cacaobonen daawerkelijk te verbeteren.

In **hoofdstuk 7** werden de belangrijkste resultaten van deze studie samengevat en werden de implicaties hiervan voor beleid besproken. De beperkingen van deze studie werden aangestipt en enkele ideeën voor toekomstig onderzoek werden geopperd. Problemen met de kwaliteit van cacaobonen op producentenniveau zijn toegeschreven aan de asymmetrie in informatie die er bestaat tussen boeren en kopers. Door dit probleem in informatievoorziening zijn kopers niet bereid te betalen voor goede kwaliteit. Dit proefschrift stelt twee beheersstructuren voor die dit probleem kunnen aanpakken. In de eerste plaats is gedemonstreerd dat de certificering van producentenorganisaties met mechanismen van traceerbaarheid, groepscontrole en meerprijzen het informatieprobleem geheel kan oplossen. Dit onderzoek heeft tevens een tweede beheersstructuur met een win-win potentieel gevonden die het informatieprobleem in de cacaosector in Ghana kan oplossen: prijsdifferentiatie met zelfselectie. Beleidsmakers zouden derhalve meer aandacht moeten schenken aan deze mechanismen, wil Ghana haar positie als een belangrijke aanbieder van kwalitatief hoogwaardige cacaobonen behouden.

About the Author

William Quarmine was born Accra, Ghana, on November 17th, 1976. William developed an interest in agriculture and rural development during his formative years in the cocoa-growing community of Sameraboi in the Western Region of Ghana. William went on to graduate from University of Ghana with BSc and MPhil degrees in Agricultural Economics in 2001 and 2005 respectively. From 2002 to 2008, He worked as a research and development professional. William also champions a number of community development initiatives such as grant-making to construct schools in rural communities. In January 2009, he started his PhD studies at Wageningen University. His study focused on how to motivate smallholder farmers to supply high quality cocoa beans through the creation of institutional conditions which open up opportunities for remunerative sustainable production.

w.quarmine@gmail.com

William Quarmine
Wageningen School of Social Sciences (WASS)
Completed Training and Supervision Plan

Wageningen School of Social Sciences

Name of the activity	Department/Institute	Year	ECTS*
A) Project related competences			
CoS-SIS course	CoS-SIS	2009	9.5
Innovation Management and Cross-Disciplinary Design (CIS 21306)	WUR/CIS	2009	4.0
B) General research-related competences			
The Methods, Techniques and Data Analysis of Field Research (RDS 33306)	WUR/RDS	2009	4.0
Advanced Econometrics (AEP 60306)	WUR/AEP	2009	6.0
C) Career-related competences/personal development			
Introductory course	WASS	2009	1.5
Competences for integrated Agricultural Research	WGS	2009	1.0
Globelics PhD School on Economics and Innovation	University of Tampere, Finland	2011	3.0
Scientific Writing	WGS	2013	1.7
Career Assessment	WGS	2013	0.3
Presentations at six (6) CoS-SIS International conferences	CoS-SIS	2010-2013	6.0
Factors which constrain farmers' incentives to enhance the quality of cocoa beans, 2010			
Enhancing cocoa bean quality through knowledge and price incentives, 2011			
Farmers' response to price and non-price incentives to produce quality cocoa, 2011			
Improving the production of quality cocoa beans in Ghana, 2012			
Institutions for improving cocoa bean quality in Ghana, 2012			
The influence of institutions on the performance of Ghana's cocoa sector, 2013			
Supervision of MSc Student	UoG/CoS-SIS	2011-2012	2.0
Total			**39.0**

One ECTS on the average is equivalent to 28 hours of course work

Abbreviations

WGS	Wageningen Graduate School
UoG	University of Ghana
CoS-SIS	Convergence of Ghana Strengthening Innovation Systems
CIS	Communication and Innovation Studies
RDS	Rural Development Sociology
AEP	Agricultural Economics and Rural Policy

What is CoS-SIS?

1 Definition and Purpose

Convergence of Sciences-Strengthening Innovation Systems is an action research programme in Benin, Ghana and Mali. It carries out scoping and diagnostic studies, agrarian system analyses and participatory field experiments with innovation platforms at the local, district and national levels. Its purpose is to identify pathways for creating opportunity for smallholder farmers in West Africa. Focusing on the enabling conditions at levels higher than the field and farm, the Programme supports sustainable intensification of smallholder farming for food security.

2 Partners and Funding

CoS-SIS is a partnership among the *Université d'Abomey-Calavi* at Cotonou, Benin; the *University of Ghana* at Legon, Ghana, and the *Institut Polytechnique Rural de Formation et Recherche Appliquée*, at Katibougou, Mali; and *Wageningen University*, and the *Royal Tropical Institute* in the Netherlands. It is funded to a total of € 4.5 million for six years (end 2008-mid 2014) by Dutch International Cooperation.

3 History and future

CoS-SIS is the second phase of CoS. CoS1 (2001-2006) focused on participatory technology development (PTD) in Benin and Ghana. It showed that smallholders can capture only limited benefits from even the best-adapted and appropriate technologies because of their constrained opportunities. Hence CoS1 researchers started to experiment with institutional change (in addition to their agronomic work). Their early results inspired CoS-SIS in that they convincingly demonstrated that institutional change is both important and feasible. CoS-SIS is currently supporting CORAF in implementing its IAR4D strategy with its West African partners.

4 Personnel

CoS-SIS employs eight post-doc Research Associates (RAs), recruited part-time from national research organisations and universities, and nine African Ph.D. researchers. Some of the RAs are graduates of the COS1 programme. The RAs facilitate Concerted action and Innovation Groups (CIGs) (multi-stakeholder platforms composed of key actors in an agricultural domain) at the district and national levels to experiment with institutional change. The Ph.D. researchers work at community level with groups of local people to analyse constraints and experimentally develop livelihood opportunities. The doctoral research feeds into the deliberations of the CIGs. The work is overseen by National, Regional and International Programme Coordinators, who together form the

Programme Management Committee (PMC). Responsibility for each country programme rests with a Programme Management Team (PMT) composed of senior representatives of universities, ministries, R&D organisations, the private sector, NGOs and FBOs. The PMTs and coordinators are proving to be high-level networkers and important advocates of the institutional change initiated by the CIGs and PhDs.

5 Domains reflect national priorities

- *Benin*: cotton, oil palm (inter-cropping oil palm and annual crops, and the oil palm seed system) and integrated water management (agro-pastoral dams in the North, and rice production in valley bottoms in the South);
- *Ghana*: palm oil and cocoa (work in the domain of small ruminants ended when the RA was promoted to another location by his home organisation);
- *Mali*: integrated water management, integration of crop and livestock production (both in the Office de Niger), and shea butter (*karité*).

6 Key activities

- Identifying key constraints that specific categories of smallholder farmers and processors experience when trying to improve their livelihoods and incomes through productive or value adding activities.
- Identifying and researching the institutional reasons for the constraints at the local and higher system levels.
- Identifying key actors, networks and mechanisms that maintain the constraints, as well as entry points for action to by-pass, or transform the institutional context to overcome them.
- Assembling multi-stakeholder platforms of key actors who can be expected to engage in institutional change in their respective domains.
- Enabling platform actors to experiment with institutional arrangements.
- Institutionalising achievements in university curricula, the programmes of research institutes, government policies, the structure of agricultural industries, and arrangements among enterprises and services and in value chains.
- Researching the processes of change and the work of the CIGs by means of real-time monitoring and a form of modified causal process tracing, based on two declared theories of change (intervention theory focused on internal and external activities and relationships of the CIGs; and power theory, focused on networks that have power to change or maintain institutional contexts linked to each domain).
- Ensuring that the outcomes of the action research are published and disseminated through international scientific media, and shared with local, national, and regional government agencies and political decision makers.