Governance, marketing and innovations in Beninese pineapple supply chains

A survey of smallholder farmers in South Benin

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To

Guaniyatou Olakitan

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GENERAL INTRODUCTION

Chapter 1: General Introduction

1.1 Preface

Figure 1: Target countries in CoQA programme (www.coqa.nl)

Quality has become an important parameter in the production and marketing of food products. Yet, smallholder farmers, particularly those in Sub-Saharan Africa, often face difficulties in meeting quality standards. This can be due to a lack of resources and a range of institutional and organizational constraints (Ruben, Tilburg, Trienekens, & Boekel, 2007; J. Trienekens & Zuurbier, 2008; Ziggers & Trienekens, 1999). Technical innovations in cultivation, product design, processing, storage and logistics may well improve the quality of fresh products (Vorst van der, 2000) but implementing such product and process innovations often requires complementary organizational and institutional innovations. Meeting the increasing quality demands of modern food chains therefore requires integrated approaches of co-innovation that complement these new technologies with changes in the organization of the value chain and the institutions involved in it.

The Co-Innovation for Quality in African Food Chains (CoQA) programme is a programme funded by INREF (the Interdisciplinary Research and Education Fund of Wageningen University). CoQA is examining integrated quality solutions in three countries, with a focus on different products: Benin (pineapple)*,* South Africa (citrus/deciduous fruit) and Ethiopia (potato). It does so from an interdisciplinary perspective, including agronomy, development economics, business economics, food technology, management, logistics, marketing and consumer behaviour and development studies. The key problems that CoQA seeks to address – solving quality issues and improving market access in developing countries' agri-food value chains – demands an interdisciplinary perspective, as these are neither purely technical nor purely

organizational problems. The CoQA programme follows a coordinated approach with each PhD student focusing on a specific problem but also involved in furthering the overall understanding of the complexity and interactive nature of the programme. The main objective of CoQA is to analyze and design quality co-innovations (i.e. integrated quality solutions that combine different approaches) that can support smallholder producers in tailoring the quality of their products to the demands of their customers in national and international supply chains, thereby strengthening their access to markets and their competitiveness.

The CoQA programme aims to produce three types of output. First, it intends to build scientists' capacities, both in the three participating African countries and in Wageningen. Second, CoQA aims to produce academic publications. Finally, it will deliver insights and generate recommendations for policy makers, businesses, NGOs, and producer organizations on policies and strategies for co-innovations that can lead to quality improvement in agrifood chains. These will be relevant not only to the target products in the selected countries but also be applicable to other value chains in other developing countries. The present study, on governance, marketing and innovation in Beninese pineapple supply chains is one of the outputs of the CoQA programme.

1.2 Introduction

Despite a growth in per capita income, from US$ 570 in 2005 to US$ 780 in 2010 (World Bank, 2012), Benin still ranks as a 'less developed country'. The country has engaged in important economic reforms, which have contributed to a sustained economic performance, with an average annual growth rate of 4.3% between 1990 and 2009. However, the developmental outcomes of this growth have been limited by relatively high population growth (3.1%) and regular fluctuations and instability in food prices. The government has worked to improve the population's access to basic social services such as education, health and water. Other sectors, such as agriculture and road infrastructure remain big challenges and still need improving. Benin's economy heavily relies on the agricultural sector, notably cotton, as well as on re-export trade to neighbouring countries. Cotton remains the country's major export commodity, generally representing 70% of total exports, although its share has declined from 75% in 1996 to 40% in 2008. This implies vulnerability and underscores the need to promote economic diversification. Benin's agricultural production systems are extensive, mostly relying on family labour, with no or limited use of improved or appropriate inputs. Aside from cotton, the main agricultural exports are fruits, and nuts and oilseeds. The sector faces the challenges of diversifying exports, increasing food production, sustainably increasing farm productivity and reducing post-harvest losses.

The country's Growth and Poverty Reduction Strategy (World Bank, 2010a), identifies pineapple (*Ananas comosus*) as one of the crops that can diversify agriculture and contribute to exports. The supply of pineapple in Benin largely exceeds national demand. However, the development of the pineapple supply chain, like many other agri-food chains in Benin, is hampered by several structural and infrastructural problems. These include financial and physical constraints on access to suitable agricultural equipment, the inputs needed to improve yields and attain production growth and to packaging and cold chain facilities (to increase shelf-life and reduce product losses). Producers often lack technical knowledge, the chain actors are poorly organized and there is a lack of finance for agriculture (Adossou, 2012; Arinloye, Hagelaar et al., 2010; Mongbo & Floquet, 2006).
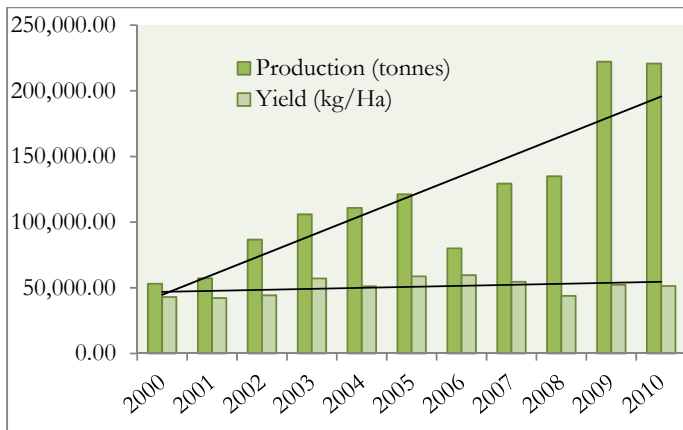
Figure 1.1: Fact and trends in pineapple production and yield in Benin (FAOSTAT, 2012)

It is estimated that some 490,000 hectares (circa 7% of the country's farmland) is suitable for pineapple production[1]. This suggests a significant potential for developing the pineapple value chain in Benin. Pineapple production in Benin has more than quadrupled over the past decade, despite the stagnant yield per hectare (Figure 1.1) and poor access to international markets (i.e. those outside Africa).

Production has grown largely due to increasing demand from regional markets, especially Nigeria. Farmers' access to international markets (in the EU and Asia) is limited by high quality and standards requirements covering agricultural practices such as traceability, pesticide residues, hygiene, etc. (Garbutt & Coetzer, 2005; Kleih, Ssango, Kyazze, Graffham, & MacGregor, 2007). Farmers' ability to comply with these market requirements is hampered by their weak technical and managerial practices. One consequence of this is that the pineapples produced are highly variable in quality. To sell them (at a decent price) farmers need to target various markets with diverse governance structures (GSs).

1.3 Problem statement and objectives of the study

The increasing globalization and internationalization of trade increases physical distance between producers and end-consumers of food products. As a result, actors at both ends of the supply chain are unaware of each others' needs, quality issues, constraints and challenges. In low income countries, this is reinforced by high transaction costs between chain actors. It obvious that the governance mechanisms which structure interactions between buyers and sellers have an

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[1] Data provided by CeRPA (*Centre Regional de Promotion Agricole*, Atlantique-Littoral), the Regional Center of Agricultural Promotion during an interview in 2009

influence on transaction costs, cooperation, collective actions and trust among supply chain actors (Williamson, 1985). A reduction in transaction costs and a move towards risk sharing among actors can also contribute to improving quality and the value added, and promote socio-economic reforms that will lead to better coordinated chains and enhance smallholder actors' bargaining power (Ruben *et al.*, 2007).

In spite of the growing amount of literature in the field of chain governance (Ferto & Szabo, 2002; Peter Gibbon, 2003; Sabidussi, 2009; Zaharieva, Gorton, & Lingard, 2003), there is little empirical evidence from low income Sub-Saharan African (SSA) countries. These countries are mostly characterized as having high transaction costs, a weak capacity to comply with required food quality norms and standards (Faber & Roelfsema, 2001), and a lack of appropriate infrastructures (roads, electricity, packaging, cold chain facilities, etc.). However, there is little evidence to explain the aspects of governance mechanisms that influence chain actors' choices about participation in different supply chains. Benin's pineapple supply chain (PSC) offers a portfolio of governance structures (GS), ranging from spot markets to collective actions. Farmers have to simultaneously make several choices about how to sell their pineapples. The quality levels of the pineapples varies, which influences which markets they are sold onto. There is currently a lack of scientific evidence on the determinants and factors that affect these multiple choices of GS. This has led this research to explore the intrinsic (the characteristics of the farm and the farmers) and extrinsic (enabling institutional support, market and transaction attributes) factors that could affect farmers' choices about GS in the PSC and whether such choices are independently made or inter-related, This is relevant, since while traditional economic theories on the comparative advantage of suppliers in selecting the GS have significantly contributed to understanding trade at the local and international levels, there is little empirical evidence to explain how chain actors make multiple choices of GSs.

It is recognized that producers in low income countries face significant obstacles. These include the lack of an enabling environment that offers institutional and infrastructural support, the lack of availability of resources and inefficient and ineffective coordination in value chains. Smallholder producers are at a particular disadvantage: they have little capital to invest, use

traditional techniques, are dependent upon family labour and lack contact with (international) market players.

The literature on participation in market channels has a relatively long history, with most of the work dealing with the nature of the producer-distributor relationship (Artle & Berglund, 1959; Coughlan, 1985; van Tilburg & van Schalkwyk, 2012). However, these studies have not modelled simultaneous participation in different market channels nor did they take into account the role of product quality and suppliers' bargaining power as potential determining factors.

Smallholder farmers generally lack vertical linkages and are rarely collectively organized which, many claim, results in their exclusion from marketing channels that supply international (export) markets (Delgado, 1999; Fenwick & Lyne, 1999; Jari & Fraser, 2012; van Tilburg & van Schalkwyk, 2012; Wynne & Lyne, 2004). These observations have been mainly drawn from the South African context, and this study tests these in a different economic context (Benin's pineapple supply chain - see Figure 4.1 - where most pineapples are sold into the national and regional markets, for example to neighbouring Nigeria) which have less stringent quality and standards requirements than European markets.

This issue of information asymmetry becomes more pronounced when there are more intermediaries (collectors, middleman, wholesalers and retailers) along the supply chain. If there is asymmetry between farmers and buyers in information about prices, the market for agricultural produce may allocate resources inefficiently, either through moral hazard or adverse selection (Akerlof, 1970; Holmstrom, 1979; Ozer & Wei, 2006; Resende-Filho & Hurley, 2012). These informational problems could be avoided if farmers could access accurate market information, such as current prices (Mikami, 2007). The introduction of mobile phones has brought new possibilities for people to communicate and share information on markets and services. Most SSA countries have mobile phone services that provide accurate and up-to-date market information. These are often financially supported by government, development projects, investment programmes and international partners for development (Donner, 2009; Donner & Escobari, 2010; Kizito, 2011). Much has been written on the role of information and communication technologies in Africa, the factors that affect the spread of mobile coverage and the impact of the mobile phone use on pro-poor labour market access, employment creation and

health care (Aker, 2008; Bosch, 2009; Brouwer & Brito, 2012; Buys, Dasgupta, Thomas, & Wheeler, 2009; Lawson-Body, Willoughby, Keengwe, & Mukankusi, 2011; Maranto & Phang, 2010; Porter, 2012; Porter et al., 2012). However, most of these studies have not investigated the potential of this technology as a market information management system. Specifically, there is a lack of empirical evidence about how much smallholder farmers are able and willing to pay for market information services (excluding any potential external subsidies) and how such a system might help overcome the recurrent issue of (price and quality) information asymmetry in supply chains.

Thus, the overall objectives of this study are to identify and characterize determinants of governance structures and marketing channels selection by smallholder farmers in Benin's pineapple supply chain and use this knowledge to identify an innovation that could overcome market information asymmetry. To reach this mail goal, following specific research activities were undertaken:

- In the first stage, the study maps the pineapple supply chains with particular emphasis on the forms of relationships between chain actors, the constraints and challenges they face and their strategies for improving quality and market access. This helps shed light on the GSs employed by small-scale producers to reduce their transaction costs and enhance their participation in high value supply chains in the absence of adequate institutional support.

- The second stage we provide empirical evidence on the determinants of choice of governance structure (GS), based on the logic of transaction cost theory. This considers the 'connectedness' of a transaction as a determining factor in explaining the choice of GS, and further explains why smallholder farmers generally opt for multiple governance strategies in their transactions.

- Third, we investigate the determinants of smallholder farmers' decisions about participation in marketing channels. It uses this information to make policy recommendations and discusses the implications of this for sustainable production and market access.

- Fourthly, we assess the willingness of a group of farmers (in Ghana) to use mobile telephony to supply and receive market and quality information on pineapples. This exercise looked at the price they were willing to pay for these services. Request partnerships among value chain actors for sustainable smallholders' access to high income markets were addressed and suggestions were made for quality and market information sharing based on multi-stakeholder innovation platform approach.

1.4 Theoretical framework

The study is based on two main theoretical approaches, which are used complementarily. The first is Transaction Cost Economics (TCE), and the second is innovation theory, with a particular focus on dynamic capabilities and incremental vs. radical innovation in technological adoption.

Transaction cost economics (TCE) is an approach for the study of economic systems and organizations. TCE is based on an integrated perspective of institutions, the law and economics (Rao, 2003). (Coase, 1937) was one of the first to recognize the centrality of the role of transaction costs in the theory of the firms. The main approach of TCE is, as Williamson (1989) suggested, to assign attribute to differentiated transactions under various GSs in a transaction-cost-minimizing manner. He viewed the firm as a nexus of contracts, and aimed to identify the GS that would provide the lowest transaction costs under different circumstances (Williamson, 1979, 1996). TCE explains why some transactions are better accomplished by using one institutional arrangement rather than another. TCE concludes that organizations should choose the spot market GS when the transaction has low asset specificity or low transaction costs, while a more hierarchical GS is preferable in high asset specificity or high transaction costs context (Greenberg et al., 2008). Bogetoft and Olesen (2004) have identified transaction costs as one of the main issues in contracting theory. However, since the assessment of the frequency specificity is subject to discussion and controversies in the literature (because of the difficulties in measuring this), this study focus on the specificity of investments, uncertainty and connectedness as a way of exploring how the attributes of transactions can influence the governance structure of agri-food chains.

In innovation theory, dynamic capabilities are referred to as the ability to sense and seize new opportunities, to reconfigure and protect knowledge, competencies and complementary assets and technologies to achieve sustainable competitive advantage (Teece, Pisano, & Shuen, 1997). This requires continuous adaptation so as to integrate and reconfigure internal and external skills, resources and functional competencies to match the requirements of a changing environment and consumers' needs. In the Beninese pineapple supply chain, dynamic capability is one of the main characteristics of actors that could influence their choice of GS and their willingness to pay for mobile phone-based MIS to overcome information asymmetry.

1.5 Outline of the thesis

The structure of this thesis is presented in Figure 1.2. there was need to first get an overview of the chain organisation as shown in Chapter 2 on mapping the supply chain and presenting further insights on the existing forms of GS as well as the constraints and opportunities associated with high quality production and matching buyers' demands. The lack of scientific evidence, on the determinants and factors affecting multiple choices of GS, led the study to explore if farmers' selections of a GS are independent or interrelated, and investigate which intrinsic and extrinsic factors might affect GS choices when alternative choices are available. *Chapter 3* therefore proposes a new construct of 'multi-governance choices', as a further contribution to the transaction cost theory literature on how and why smallholder farmers select among alternative GS in agrifood chains. *Chapter 4* investigates how smallholder farmers' characteristics, production systems, product quality and marketing context affect farmer's selection of a marketing channel under a lack of up-to-market price and quality information and low education level contexts. *Chapter 5* investigates how smallholder farmers can overcome this information asymmetry, and knowledge gap issues through using information and communication technologies (ICT). Based on an explorative case study (from Ghana) the premium that farmers are able and willing to pay to access quality and price information was assessed and recommendation made for a policy and managerial implications. Finally, *Chapter 6* discusses the main conclusions, explores their implications and presents recommendations for policy makers and practitioners.

Introduction

Chapter 1

Barriers to smallholders' participation in high value agri-food chains: Evidence from the pineapple supply chains in Benin

Chapter 2

Governance choices by smallholder farmers in pineapple supply chains in Benin

Chapter 3

Marketing channel selection by smallholder pineapple farmers in Benin

Chapter 4

Reducing price and quality information asymmetry: a mobile phone-based contingent valuation approach

Chapter 5

Conclusions and implications

Chapter 6

Figure 1.2 Thesis outline

2

BARRIERS FOR SMALLHOLDERS' PARTICIPATION IN HIGH VALUE AGRIFOOD CHAINS: EVIDENCE FROM THE PINEAPPLE SUPPLY CHAINS IN BENIN

Chapter 2: Barriers for smallholders' participation in high value agrifood chains: Evidence from the pineapple supply chains in Benin

2.1 Introduction

The increased globalization of international trade can provide an opportunity for developing and less developed countries to export high-value products to developed countries. However, the high quality standards required for such exports can also be an entrance barrier to trade. Product quality is also critical as it affects the market value of a good. This quality is determined by many attributes, some of which may be directly observable, others which can only be observed at a cost (M Fafchamps, Hill, & Minten, 2008). Problems with meeting food quality standards tend to be more pronounced in agri-food supply chains in Less Developed Countries (LDCs). This is due to a combination of factors, including: the poor quality of planting materials, poor storage and processing and a lack of capital to invest in improved technologies. This chapter analyzes the types of relationships between chain actors and the constraints and challenges facing the pineapple supply chain (PSC) in Benin, particularly in terms of quality. In spite of the growing amount of literature about supply chain governance (Boger, 2001; Ferto & Szabo, 2002; Peter Gibbon, 2003; Sabidussi, 2009; Zaharieva et al., 2003), there is little empirical evidence on the impact that it has on product quality and incomes in developing countries and particularly in Sub-Saharan African (SSA) countries, where supply chains are characterized by high transaction costs and a weak capacity to comply with the food quality norms and standards required by export markets.

The export of pineapples from Benin is a relatively new agri-food chain, which only started flourishing a few years ago. This is in contrast to other chains (e.g. those for exporting bananas and oranges from developing countries to European markets), which are well-established and have a 'settled' governance structure and where choices about channel are relatively well-established. Interviews were conducted with 55 actors, including input suppliers, producers, traders, processors, exporters and those providing supporting services to individuals and groups. The interviews sought to address the following main questions: 1) What linkages exist in Benin's pineapple supply chain (technical advice, access to finance, gifts, knowledge and information)

and how do these affect pineapple quality and farmers' access to more profitable markets?, and 2) What are the barriers to smallholder farmers' access to profitable markets and which endogenous governance structure(s) is/are established by actors to overcome these barriers?

The answers to these questions will provide a better understanding of the organization and structure of Benin's PSC.

2.2   Transaction cost theory

Transaction costs are generally thought to consist of two components (Clemons, Reddi, & Row, 1993): coordination costs and transaction risks. Coordination costs include the costs of crafting safeguards; through communication, negotiation and co-ordination; screening and selection (ex ante) and measurement (ex post). Transaction risks include the hazards that a party in the transaction will not honour an agreed arrangement, because of information asymmetry and/or opportunistic behaviour (Grover & Malhotra, 2003; J. Hobbs, 1996; Williamson, 1998). One feature of transaction cost economics (TCE) is its ability to explain the role that different governance structures play in influencing why some transactions are accomplished at a lower cost than others. Williamson (1979, 1996) uses the governance structure approach to explain a number of characteristics of transactions: bounded rationality; behavioural uncertainty; the specificity of investments and the frequency of transactions. Under the logic of TCE, organizations should opt for a spot market governance structure when the transaction has a low asset specificity, since the transaction costs will be low under such circumstances (Williamson, 1985). Transaction costs are considered to be one of the main factors influencing the type of chain governance. Ruben *et al.* (2007) hypothesized that transaction costs and risk reduction can be achieved through different chain configurations. Pineapple is a perishable product, meaning that actors at all stages of the chain need to ensure timely handling and transactions of the product. This raises the issue of the temporal specificity of transactions, which has a major influence on transaction costs. From a transaction cost perspective, firms not only need to manage their level of production costs, but also must manage the level of transaction costs associated with their exchanges with their customer of choice (Jones & Butler, 1988). To some extent, producers involved in food chains have to make a strategic choice between (a) market outlets devoted to exports where quality attributes such as size, sugar content, and the absence of any external and internal damage are the key determinants for a successful business relationship, and (b) domestic markets (i.e., rural and urban markets), where different qualities and delivery

modes can be accommodated and agreed on by buyer and seller. This decision is affected by the transaction costs implicit in these two choice – which the supplier has to bear - and illustrates the link between transaction costs and the actors' choice of channel.

Before developing the transaction cost theory perspective, this chapter first provides a description of how the PSC in Benin is organized and the transaction costs involved. This, in turn, leads to an analysis of the factors that affect smallholders' participation in different chains and characterises the existing governance structures

2.3   Data collection and methods

This study used a non-probability sampling method. This approach involves selecting respondents in a non-random manner, using convenience sampling techniques[2]. Respondents were selected based on their experience in production and trading activities, their distance from the main markets, firm size (small, medium and large), the type of market served (rural, urban, regional and international), and membership (or not) of a pineapple farmers' or traders' association,. This combination resulted in a representative and balanced sample. Different techniques were used to gather data.

Secondary data related to the whole supply chain were first collected from libraries, national public and private research and development institutes. Secondly, interviews were carried out with chain actors: 55 actors in the south of Benin were selected based on the criteria listed above. These included inputs suppliers, pineapple farmers, traders, processers, exporters, agents from the Ministry of Agriculture, NGOs, research institutes, universities, local authorities, and extension service agents. The sample was drawn from three main production locations (Departments), namely Atlantique, Littoral and Plateau all in the Guineo-Conglian and Coastal Zones (Figure 2.1). In addition, focus group discussions were conducted with five to ten producers in each production area and with traders in retailers' and wholesalers' markets. These discussions provided information related to the specific constraints and challenges in pineapple production, trading and export, the available documentation and data.

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[2] A convenience sample is often used for exploratory purposes, that is, to get different views on the dimensions of an issue, to probe for possible explanations or hypotheses, and to explore constructs for dealing with particular problems or issues. For more detail on convenience and judgment sampling techniques see Marshall (1996) and Ferber (1977)
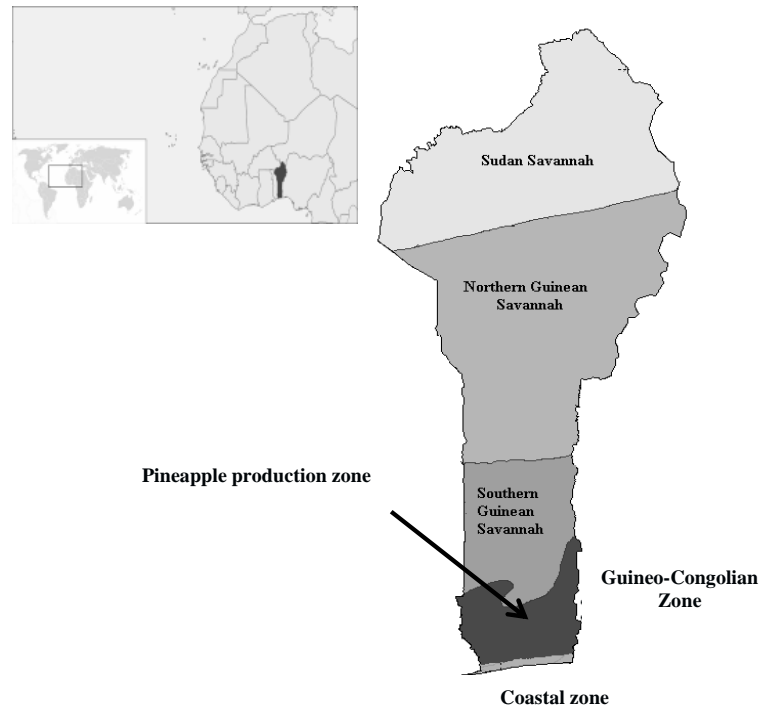
Figure 2.1: Pineapple production area

2.4   Results

2.4.1 Overview of the pineapple supply chain in Benin

To have a good understanding of the reasons that guide chain actors' choice of governance structure, it is necessary to have an overview of how the chain is organized. The organization of the chain and the actors involved are discussed below.

Pineapple production

A wide range of producers are involved in pineapple production in Benin. They differ in terms of their farm size, scale of production, technical and financial capacities and access to inputs, land and labour. Nevertheless, pineapple farmers can roughly be divided into three different categories: small, medium and large-scale producers.

Small-scale producers have a plantation size of between 0.5 and 1 ha, the medium-scale producers have 1 to 5 ha and the large-scale producers have more than 5 ha. There are many small-scale producers and very few large-scale producers. In between, there are a number of medium-scale producers. The exact numbers of pineapple producers in Benin is difficult to estimate, due to a lack of statistics. In general there has been a steady increase in their numbers in recent years, as the price of pineapples compares favourably to that of other commodities. Women are strongly represented, more than in most other commodity production, and are estimated to make up about 15% to 30% of the total (Agbo, Agbota, E., & Akele, 2008). Large-scale pineapple producers often cannot meet the quantities and delivery dates required by the international markets and often collaborate with small and medium-scale producers (outgrowers) to reach the quantity required for export.

Not all pineapples are eligible for the European and Asian markets. If the pineapples are too small or too big they are not accepted in these markets and, instead, are sold in domestic and regional markets at a lower price.

The principal inputs needed for pineapple production are planting materials, fertilizers and growth regulators, such as Ethephon[3] which is used to induce the uniform ripeness of a pineapple crop. Achieving this physical uniformity depends on the quantity of Ethephon used, which generally leads to residues that exceed the MRL (Minimal Residual Limit). According to ColeACP (Europe-Africa-Caribbean-Pacific Liaison Committee) the residual dose should not be high than 0.2 ppm[4]. According to the Industry and Trade Chamber of Benin, most pineapple farmers are not aware of, or ignore this residual limit.

In the 1920s, Ethephon was discovered to be an effective way of artificially inducing flowering in pineapple (Burg & Burg, 1966). Floral Induction Treatments (FIT), using ethylene, allow the farmer to control the production cycle and can have many economic and social benefits. These include the uniformity of the fruits, the concentration of the harvest at the desired time, the control of diseases and ultimately, the efficient use of labour (Lebeau, 2009). Pineapple farmers

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[3] Ethephon has a substantial commercial value as a plant growth regulator with the trade name Ethrel. The chemical name of this compound is 2-Chloroethylphosphonic-acid. For more details see Qu, *et al.* (2004).
[4] One of the major advantages of the MD2 cultivar from Costa Rica, which is now also grown in Ghana and the Ivory Coast is that it does not needing an Ethephon application to achieve a uniform ripeness and colouration. This variety is still only experimentally grown in Benin.

generally apply an FIT eight months before harvesting, inducing plant flowering two months later.

The production life cycle of the pineapple (i.e. the period from planting to harvesting) varies from 14 to 18 months, depending on the maturity of the growing material, which generally weighs between 300 and 600g. To spread the harvest and obtain uniform pineapples, producers sort the planting materials before planting them based on their weight. Pineapple quality is also affected by cultivation practices, such as the fertilizer dose. At present, there is no specific fertilizer formulation in Benin for pineapple production. The fertilizers used are the same as those applied to cotton or are imported from Ivory-Coast, (which has different agro-ecological conditions). According to experts the optimal K/N ratio, which is 2.5 for pineapple production in Benin, is not met. According to farmers in Allada district, the unbalanced mineral intake negatively affects fruit quality and saps soil fertility.

The extension service of the Atlantic Department estimates that, in 2009, there were around 4,000 pineapple producers in Benin, mainly located in the south of the country. Production has increased almost fourfold over the past decade (confer Figure 1.1 in Chapter 1). This improvement is the result of the growers' increased interest in pineapple and extensive pineapple production. The biggest fresh pineapple outlets are the national fresh pineapple markets (rural and urban) and regional markets in Nigeria, Niger, Burkina-Faso and Togo. In 2009, it was estimated that less than 2% of the production was exported to Europe, which is far below the export potential, given that Benin has favourable production systems, coastal access, and well appreciated cultivars.

Mapping Benin's pineapple chains

There are five main supply chains for pineapple in Benin: the domestic fresh chain, the domestic juice chain, the regional fresh chain, the international fresh chain and the processed pineapple chain (Figures 2.2 and 2.3).

Domestic fresh consumption: this marketing channel is one of the major outlets in Benin, absorbing about 35% of production in 2010. The produce is sold at urban (Dantokpa in Cotonou) as well as rural (Glo-Djigbé, Sekou, Sèhouè, Zinvié, Ouegbo, Ze, etc.) markets.

The regional market for fresh pineapple: the supply of pineapples in Benin exceeds national demand. Therefore, producers need to find other marketing channels to sell their surplus pineapples. Although there are no official statistics on the quantity of pineapples exported to neighbourhood countries, it is estimated to be around 40% of national production. Wholesalers in Dantokpa market (Cotonou) stated that the Nigerian market alone absorbs more than 40% of national production.

Juice from fresh pineapple: pineapple juice is produced in traditional and semi-industrial processing factories and packed in 0.25 or 0.33 litre bottles. This market channel is not well developed and is dominated by single producers or producers' associations. The juice is mainly sold on the domestic market and not exported to Europe, because of shelf-life difficulties. This channel consumes almost 15% of national production (which increases the domestic consumption of fresh pineapples to about 50%).
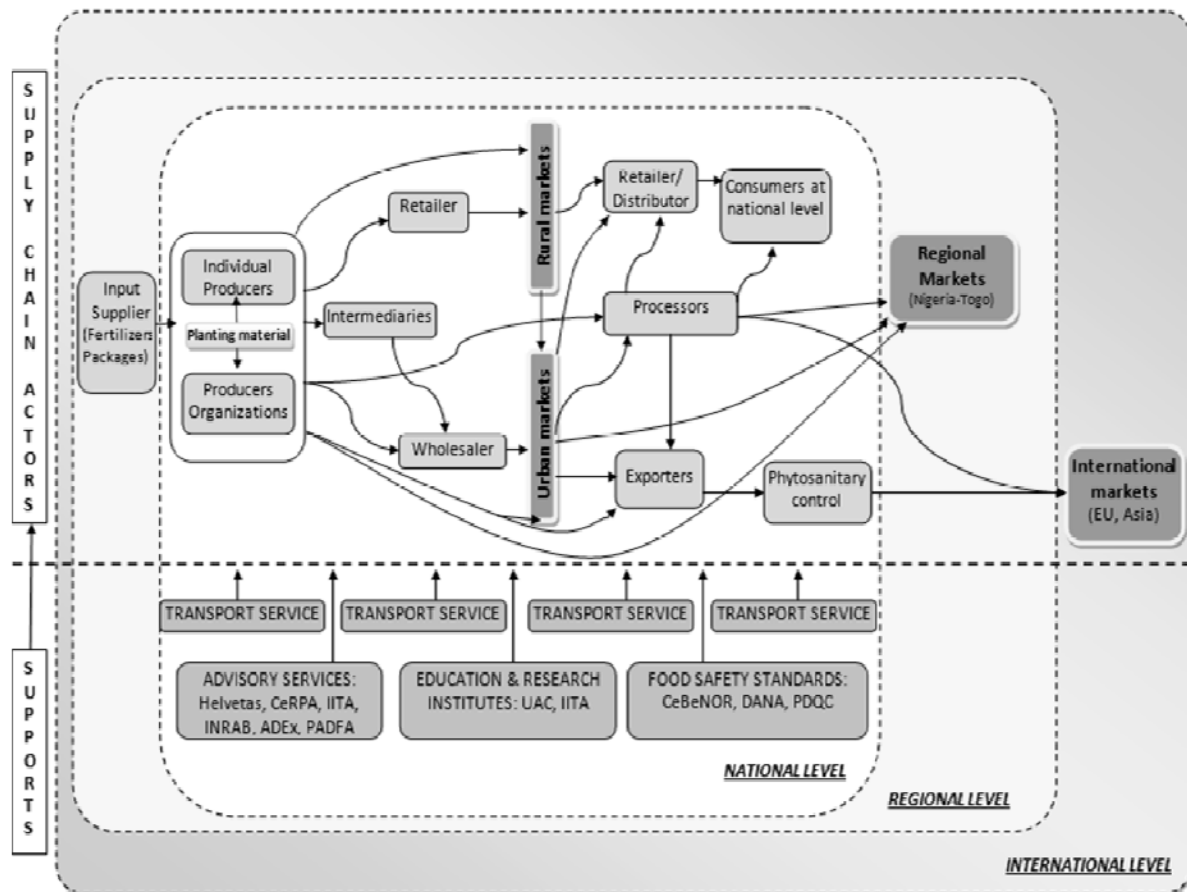
Figure 2.2: Map of Benin's pineapple supply chain
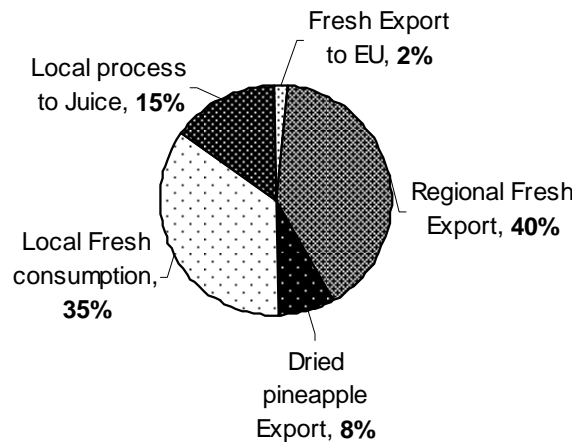
Figure 2.3: Fresh and processed pineapple markets (Adapted from Agbo et *al.*, 2008)

Fresh pineapple exports: the international market (beyond West Africa) accounts for about 2% of total production. This market includes EU countries (France, Belgium, Luxembourg, Italy, Germany, the Netherlands, etc.), Asian countries (United Arab Emirates and Saudi Arabia) and North African countries (Algeria and Libya). Exports, either by air or by sea, are problematic. Until 2008, plane freight cost 518 €/tonne by KLM/Air France and 609 €/tonne on DHL[5]. By boat, the freight cost is 380 €/tonne, less expensive than by plane, but it is necessary to ship quite large batches. International exports require a wide range of additional inputs (boxes, bags, and other packaging materials) to ensure that the perishable fruit is effectively conserved. These inputs need to be available and affordable.

Dried pineapple and marmalade export chain: this market channel is not well developed. The major destinations are France, Switzerland, Belgium and Austria. The Tropical Fruit Drying Centre (CSFT-Benin) is the main factory that supplies dried pineapple export from Benin, including pineapple marmalade and syrup.

The research has shown that the price of pineapple in the domestic and regional markets varies significantly throughout the year. This is in contrast to the international market, where the wholesale pineapple price is defined by the exporters and is relatively stable throughout the year. During the production campaign of 2009-2010 fresh exporters were paying €183 for 1 tonne of

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[5] Data provided by ADEx (*Association des Exportateurs*), the association of exporters in Cotonou-Benin during an interview in 2009.

pineapple and processing factories €152 (see Table 2.1). These prices include other transaction and supervision costs: the actual farm gate price was €143/tonne and €137/tonne respectively.

Table 2.1: The components of the price of fresh and dried pineapple paid by exporters and processors

Description		*Processor price (€)*	*Exporters price (€)*
1. Gross price paid (A)		152.4	182.9
2. Intermediate costs (B):	*Tax/charge*	6.1	-
	Conditioning	-	4.6
	Handling	-	1.5
	Communal supervision	-	3.0
	Village supervision	1.5	0.0
	*Administration fees**	7.6	10.6
	Ethephon application	-	19.8
3. Farm gate price received by farmers (A-B)		137.2	143.3

* Administration fees include the deductions made by RePAB (Network of Pineapple Producers of Benin), UGPAT and district authorities. Source UGPAT[6]

€ 1 = 655.975 FCFA

Participation in the export chain involves fulfilling certain quality attributes, such as size, sugar content, and the absence of external and internal damage. These attributes determine the price paid. The lowest prices for pineapple in the rural, urban and regional markets are recorded during May and June. One respondent indicated that one of the main causes is market competition with other fruits (oranges, mangoes, and bananas), which ripen in the same period. Farmers selling at this time generally record huge losses, but these can be compensated for by an increase in price from July to September. During this period, the average price of 40 pineapples[7] can be as much as US$30 corresponding to US$0.75/kg (for the *smooth cayenne* cultivar). The causes of this annual cycle of price fluctuations are explained below.

First, pineapple production in Benin mainly depends on natural rainfall patterns that do not allow farmers to apply inputs (mainly fertilizers and Ethylene for FIT) during the dry seasons. In south Benin the dry season occurs in December, January and early February. It is difficult to apply the FIT at this time, meaning that there is a shortage of pineapples eight months later, between July and September.

Second, there is a socio-cultural condition that affects the profitability of pineapple chains: Muslims' fasting period generally falls in the period between July and September. During this period there is a peak in the demand for fruits, and the local prices experience a significant increase. In the normal season a bunch of forty *cayenne smooth* pineapple might fetch between 2500 to 3500 FCFA[8] and even as little as 1500FCFA. In the period of Ramadan the same fruit might sell for between 4000 and 5000FCFA and large size fruits might even reach 11000 FCFA. The market price for the *Sugarloaf* variety is normally between 1500F and 2000F (for forty), but can increase to 2500 or 4000 FCFA during the fasting period. Aware of this price fluctuation, farmers now try to managing their production systems so they can produce during the peak price season.

Third, a similar pattern of seasonal demand from other neighbouring countries with significant Muslim populations, such as Nigeria - with more than 160 million habitants (which accounts for more than 35% of national production) and other landlocked countries (Burkina Faso and Niger) adds to this high price.

The size of pineapples also affects channel choice. When harvested, pineapples are generally sorted in two categories. The first category is uniform in size and shape and fit well into packaging boxes. This category of pineapple is exclusively reserved for the export markets. The remaining pineapples, of variable sizes, are sold on the domestic (urban and rural) and to regional (neighbouring country) markets, either for direct consumption or to be processed. Clearly the price for these two categories differs. This strategy of channel differentiation allows farmers to sell their low quality products at low prices instead of throwing them away if rejected by exporters.

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[8] $US1= 502 FCFA during data collection in 2009

2.4.2 Barriers to smallholders' development

Financial access

Financial markets in developing countries and particularly in Sub-Saharan African (SSA) are largely underdeveloped, lacking in depth, highly inefficient, concentrated in urban areas and dominated by a few, often foreign-owned, commercial banks (Mpuga, 2010). Benin's financial sector is no exception: underdeveloped, and concentrated in urban areas, leaving the majority of the agricultural producers and the rural population with no access to finance. One of the major constraints faced by pineapple farmers is the difficulty in accessing financial support for their activities. Establishing one hectare of pineapple requires an average initial investment of around $US 4,500. Raising this amount is beyond the financial capacity of more than 90% of producers (Agbo *et al.*, 2008). Therefore, most farmers need access to credit or a loan. However, the available credits and loans are inappropriate for pineapple cultivation for two main reasons. Firstly, because of the long production cycle of pineapple (14-18 months) financial institutes are unwilling to provide credit. Secondly, the high interest rate (between 36% and 47% from Micro Finance Institutes - and as high as 20% a day in the informal sectors - walking banks, groups, informal lenders, etc.) are a disincentive for pineapple farmers. Moreover, the short repayment period of such loans (6 months) makes them unsuitable for pineapple production, (where the cycle is 14-18 months).

Personal savings and relationships remain the main source of finance for most producers. Some receive pre-financing in-cash (for labour payments) or in-kind (for fertilizers, pesticides and planting materials) from pineapple traders and/or exporters. This (should) give traders a guarantee that they will obtain the fruits at harvest (see box 1) and allows the farmers to produce. Some producers argue that this arrangement is not profitable for them as some traders buy at below production cost prices. However, most producers who receive loans from exporters do not complain about the profitability of the arrangement since the purchase price (per kilogram) is pre-determined and stable. This form of arrangement makes small-scale actors dependent on a specific governance structure, namely a relational contract or an outgrowing scheme.

Quality issues in the pineapple supply chain

In recent years, increased consumer awareness has given rise to higher consumer requirements. In response, international standards have emerged. The original goal of standardization was to balance consumers' and producers' interests and to promote socially responsible behaviour (Ruben *et al.*, 2007). In Benin, however, the cost of complying with EurepGAP standards has forced smaller growers out of the international market. The standards aim to introduce more transparency into agri-food chains. Since the costs of monitoring for compliance are essentially the same for a large and a small firm, small firms face high inspection costs unless they can obtain compliance certification for a large number of farms linked by common practices into groups, associations or cooperatives. Some pineapple producers' unions (e.g. UGPAT) and processors (e.g. CSFT), who meet the standards and requirements of ISO and Fair Trade have done this.

Smallholder farmers can realize scale efficiencies through collective actions that help them to meet international standards and provide either substantial premiums or access to new markets otherwise unavailable to them. Most individual small-scale producers are unaware of these international standards. They are more familiar with consumer's quality standards in domestic (Cotonou, Porto-Novo, Calavi, Sème, etc.), border and regional markets (Krake, Lomé, Grand Popo, Lagos, etc.), which are largely taste related. The difficulties that most farmers have in complying with these standards have restricted the number of fresh pineapple exporters to two major companies (*Fruit Tillou* and *Fruit d'Or*). This is one contributory reason why the majority of fresh pineapple is sold either on national or regional markets.

Despite the existence of national institutes and support services (CEBENOR, PDQC, CeRPA, etc.) involved in quality control and building the capacity of actors to comply with quality standards (Figure 2.2), there is still a need to refine and redesign the chain coordination mechanism. Investments are needed if small and medium scale producers are to be able to respond to quality norms and standards (for regional as well as international markets). Such investments are needed to provide safe on-farm storage facilities for (small quantities of) pesticides, disposal pits for waste chemicals, hand washing facilities, personal protective equipment, knapsack sprayers, certified planting materials, etc. However, most small-scale pineapple producers lack the financial capacity to make such investments.

It is also important to emphasize the lack of adequate transport facilities. Trucks and cars are often used to ship pineapples to market and it is common that the pineapples at the bottom of the truck are damaged, due to the poor state of the roads and a lack of sturdy packaging materials. Wholesalers in Dantopka market confirmed that the recorded losses due to inappropriate transportation can be as high as 20%.

Production systems

Benin has an estimated 490,000 hectares suitable for pineapple production, (circa 7% of farmland nationwide). In the Atlantic Department, land suitable for growing pineapple is subject to speculation. The high cost of labour is another major problem for small-scale producers in the expanding pineapple production area. Farmers can use herbicides to overcome the scarcity and high cost of the labour but this can have negative effects on the environment and their health. While there are many farmers' organizations in the region, only few of them are functional and well organized – many are affected by recurrent internal conflicts amongst members. Because of a lack of knowledge and financial support to farmers, yields on small farms areas remains low (confer Figure 1.1.). Based on extensive production, pineapple production in Benin exceeds national demand. This sometimes forces producers to sell their produce cheaply or, in the worst case, let it rot in the fields (Tidjani-Serpos (2004).

Transaction costs and conflict management

Pineapple production and marketing involve high transaction costs. Traders in Dantokpa Market and the farmers that transport their pineapples to the urban markets stated that they face many informal costs (including corruption and bribes), administrative constraints, border controls, and unbalanced market information (information asymmetry). These costs generally account for 10% to 15% of total turnover. This is in line with the findings of van der Meer (2006) who argues that transaction costs can be reduced by shortening the supply chain, bypassing traditional intermediaries and if corruption can be avoided (Collier, 2000). Other transaction costs faced by actors in the supply chain include: the cost of searching (for information on prices and good quality pineapples), negotiation (time, facilities, etc.), inspection (to ensure conformity between

the end-product and the specification), and enforcement (non-fulfilment or lack of respect of the contractual agreements).

In Benin there is a common contract arrangement mechanism that sometimes leads to conflicts between farmers and traders. Traders give money in advance to producers to facilitate the supply of fertilizers, planting materials and other inputs. Usually, traders and farmers write down the elements of their agreement, which specifies the recipient's acknowledgment, the price and place of harvesting and the signature of both parties. Unfortunately, this contract arrangement is not always fulfilled. The following example, from a 2009 interview, gives an idea of how such a conflict arises and was resolved.

Box 1: Transaction costs related to conflict resolution between buyer and seller

In order to acquire inputs (planting materials, fertilizers, pesticides, herbicides and labour), a pineapple producer asked a wholesaler in Dantopka for a loan of €300. It was agreed that the loan would be reimbursed with two full trucks (known locally as bâché) of fresh pineapple. Fifteen months later, the trader learnt that the pineapples were ripe and ready to be harvested. One week later he was surprised to learn that the producer had harvested the entire crop and sold it to another trader. The first trader went to get the assistance of a police officer, using the signed agreement letter as proof of the transaction. One week after an intervention by the police officer, who temporarily seized the producer's motorcycle, the producer was obliged to reimburse the entire loan. The transaction cost related to this contract enforcement and the conflict resolution was roughly estimated by the trader at €70, excluding other opportunity costs (time lost and communication costs).

In international high-value supply chains, contracts between producers and buyers are becoming increasingly important. These contracts cover a range of parameters, such as quantity, quality and price. Production contracts can improve the coordination of a chain and reduce risks. In agriculture, such contracts are known to play three major roles. First, they improve predictability, allowing farmers to allocate resources with greater confidence. Second, they allow market participants to share risk, and third, they are contribute to increase performance (Hueth, Ligon, Wolf, & Wu, 1999). However, it is not clear what the main incentives are for small-scale pineapple producers to engage in contracts with other supply chain actors. Written contracts that specify the main attributes of the a transaction can be useful in preventing a divergence between the offer and demand in terms of quality and quantity.

2.4.3 Governance structures

The governance structures (GSs) most often found in tropical agri-food chains, such as in Sub-Sahara Africa, consist of spot market, relational contracts, producer organizations and a combination of contracts and collective action (Key & Runsten, 1999; Stockbridge, Dorward, Kydd, Morrison, & Poole, 2003). Governance structures are chosen when they are the most efficient way to carry out a transaction (Williamson, 1991). While Williamson focused on three generic forms of GS (market, hybrid and hierarchical) and three attributes of transactions (asset specificity, frequency and the uncertainty related to opportunistic behaviour), in reality there is a myriad of intermediary forms of governance. These (hybrid) forms include long-term contracting, joint ventures, relational contracting and bilateral governance. Altenburg (2006), emphasized that shifting from an anonymous or spot market-based exchange of products to a more durable, vertically coordinated arrangement, that gives a more prominent role to the leading firms, can have many implications for chain management.

Pineapple producers, especially small and medium scale ones, need to make investments in order to be able to respond to quality norms and standards for regional and international markets. As they lack the financial capacity to make these investments, many are involved in a form of arrangement known as 'outgrowing'. An outgrowing scheme allows small-scale producers (outgrowers) to benefit from a relationship with larger exporting and processing companies and wholesalers. In this form of governance structure, the buyer takes the lead in some or all of the following: (1) controlling production and harvesting practices on farm to ensure pineapple quality, (2) providing the farmer with a loan to buy inputs and accomplish the production on time, or (3) directly supplying inputs (growing materials, Ethephon, fertilizers, etc.) to farmers as a form of credit, and (4) training farmers on good production practices and monitoring their progress. This type of scheme is generally backed up by short or medium term contracts (one harvest or one production cycle). Garbutt and Coetzer (2005) argue that when small-scale farmers associate with exporters as outgrowers this brings mutual benefits. The small-scale producers rely on the exporter to get advice and a supply of inputs, while the exporter gets a predictable supply of high-quality crops that satisfy the importer's requirements. Many, development organizations promote outgrowing schemes, as they see this as a way to create improve the livelihoods of producers and advance the competitiveness of developing countries (USAID, 2009). Both of Benin's pineapple export companies (*Fruit d'Or* and *Fruit Tillou)* run this form of partnership that still needs to be structured and organised with clear and formal contract

terms, legitimated by the government. *Fruit Tillou*'s has 157 small and medium-scale producers (0.1 - 5 ha), in its outsourcing scheme, who produce pineapple on the basis of agreed arrangements: some are members of the pineapple producers' union (UGPAT), others are individual producers. To manage the outgrowing scheme, the exporter employs full-time staff, who devote their time to resolving issues that these small-scale producers may have in complying with the required norms and standards.

The idea of outgrowing started from the traders and exporters' desire to reduce the high transaction costs related to transact with individual farmers and to reduce the opportunistic behaviour. The outgrowing scheme helps farmers solve two issues: (1) reducing information asymmetry and the opportunistic behaviour of individual traders, and (2) to get the needed inputs and financial support to efficiently produce the pineapples at the right time. One attribute of the transaction costs that does not apply in the case of PSC is related to the frequency of transactions. Pineapple has a long production cycle (14-18 months), and the crop can only be harvested twice every three years. This means that the transaction frequency is very low. Moreover, farmers regulate the harvesting period by controlling the FIT through applying Ethephon. This allows them to harvest the whole pineapple crop at the same time, as specified by the buyers.

But it is not just traders who engage in opportunistic behaviour. The pineapple exporters claim that they have a major problem with small-scale producers sometimes cheating on them by selling their products to other traders who offer a higher price, bypassing established links and agreements (see Box 1). This problem is gradually being addressed through the establishment of 'semi-formal' contracts between exporters and small-scale farmers' associations, such as UGPAT, ARPA and REPAB[9].

The development of closer relationships with fewer suppliers can also create problems of transactional dependency and opportunism (Dolan and Humphrey, 2000; Hoffmann and Vossenaar, 2008). As such, a chain based on an outgrowing scheme requires a fluid, protecting and reliable institutional environment to avoid conflicts among actors. In Kenya ,this is done through existing legal structures that allow farmers to apply for a legally recognized 'self-help group' status (United Nations (2008). Such groups can only come into effect when each

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[9] ARPA is the Regional Association of Pineapple Producers and REPAB the Network of Pineapple Producers of Benin

individual farmer has signed a legally binding agreement. Similar schemes have been successfully developed in several other countries, where innovative contracts support the development of outgrowing schemes. When farmers receive support (such as improved access to inputs, credit/loans, private and public extension services) this may improve their productivity, even having spill-over effects on other crops - increasing and stabilizing farmers' incomes. This has been demonstrated in a study on green beans in Madagascar (Minten, Randrianarison, & Swinnen, 2007), where micro-contracts between wholesalers/exporters and small-scale farmers allowed the latter to participate successfully in emerging value chains, giving them access to extensive farm assistance and supervision programmes that enabled them to meet complex market requirements.

2.5   Discussion and conclusions

This chapter has discussed the governance structures that exist in Benin's PSC and the way that some of them attempt to create marketing channels that can overcome the lack of a supporting and enabling institutional environment. It has also discussed the constraints and challenges that farmers and traders face in getting a high product quality and a high and stable market price. The research shows that the production of pineapple requires certain inputs such as planting materials, specific fertilizers and chemicals for FIT. The quality of the planting material is a strong determinant of the quality of the final product. The more vigorous and healthy it is, the better the quality of the fruits (Garnier, 1997). Producers find it tremendously difficult to access these inputs. The limited supply of planting material, especially for the *smooth cayenne* cultivar, is a crucial weakness that needs to be overcome if Benin is to strengthen its pineapple production. Farmers also expressed frustration about the lack of information about where to get these materials, even when they are available. This problem is further reinforced by the lack of farmers' skills and know-how about how to develop and multiply high quality planting materials in their own nurseries. Most of farmers whom we interviewed typically lack good access to quality and market information about inputs and their final products. In addition, there is a serious deficit of storage facilities such as cooling rooms and warehouses. As a result, traders in local, urban and regional markets prefer to buy unripe pineapples which have a longer shelf-life.

The sale of fresh pineapple on international markets is restricted by different problems. For shipments by boat, it is necessary to combine pineapples from various producers and, if there are

problems, it is very hard to tell which producer at fault. So, there needs to be a traceability system to know which pineapples came from where. *Fruit d'Or* experimented with exporting pineapples by boat in 2007 - their experience was not positive and they stopped using this channel. The problems they faced included an absence of cold chain facilities in the harbour, insufficient quantity of produce and the long transit time.

Ghana has seen rapid rise in pineapple exports since the late 1990s, the main destination being the EU (especially Belgium, France and the United Kingdom). This increase was due mainly to the introduction of sea freighting, which overcame the problem of limited and expensive air cargo capacity (also freeing up air cargo for higher value products). Benin could learn from this experience and re-design its PSC in such a way that sea freighting may be viable.

As stringent international regulations on quality norms and standards pose significant challenges to many small-scale pineapple producers and exporters in Benin. Alternatively, other strategies for increasing market access could also be explored. Such alternatives should be complementary to the existing ones, rather than seek to substitute them. The most important of these consists of assisting small-scale producers to develop cross-border trade. Benin has a strategic geographical position that makes it one of the transit countries for West Africa's land-locked countries, such as Niger, Burkina-Faso and Mali as well as neighbouring countries, such as Nigeria and Togo. More than 35% (Agbo *et al.*, 2008) of Benin's total pineapple production is already transported to those countries (mostly Nigeria), where the requirements for quality norms and standards are less stringent than in the EU. (Kleih *et al.*, 2007), in their study on the impact of EurepGAP on small-scale fruit and vegetable growers in Uganda, found that there are rich opportunities for cross-border trade. It is important to secure these markets in the short-term as this might prove more lucrative and sustainable than a riskier focus on overseas markets.

Improving processing and packaging processes would help producers, processors and exporters cope with Europe's more stringent food safety requirements. Standards for processed fruit and vegetables can be easier to comply with if producers can meet good manufacturing practice requirements (Verkerk, Linnemann, & van Boekel, 2007). For example, Kenya and Madagascar have substantially increased their share of EU imports of processed beans; the Ghanaians are seeking to increase their exports of sliced pineapple and pineapple juice; and Senegal has upgraded the quality of its exported green beans, which led to a remarkable increase of amount exported to the EU since 2006 (Maertens, Dries, Dedehouanou, & Swinnen, 2007).

The lack of adequate market information can increase transaction costs. For Benin's PSC to become more efficient there is a need for a centralized information system and coordinated links that can help small-scale producers, traders and exporters to increase their profit margins while reducing transaction costs related to information asymmetry.

It is possible that the costs of coordinating small-scale producers to ensure that they comply with the stringent requirements of international markets may actually make them less profitable. This problem could be avoided by focusing on alternative markets, the regional markets and/or less demanding export markets. The fluctuation of the pineapple price throughout the year –means that the price on the Nigerian market can be higher than that on the international market (e.g. 0.46 €/kg in Nigeria compared to 0.14€/kg in the EU). This could constitute a competitive advantage that could be exploited if the chain actors were better organized. Furthermore, regional markets may provide a practical option for numerous small-scale producers to overcome logistical problems (lack of road transport, cold rooms etc.).

The domestic market may also provide profitable options for smallholders, through processing to add value to pineapple products. This approach has been successful in other countries, such as Ghana, where prices for processed mangoes on domestic markets are reportedly high (Berg & Fiege, 2006).

This exploratory study shows the need to investigate the incentives for small-scale pineapple producers' to engage in contracts with other supply chain actors. Written contracts can be used to specify the main attributes of the transaction in the outgrowing schemes, thereby contributing to a reduction in transaction costs. In this way they can help balance the supply and demand (in terms of both quality and quantity). Outgrowing schemes could also provide a mechanism for more effectively tapping into the Nigerian market, through formalizing trading arrangement (i.e. through the involvement of a third party in contracting to safeguard the investments). This arrangement would be helpful in reducing the informal transaction costs paid by actors along the PSC due to market information asymmetry. It would also help reduce bounded rationality and opportunistic behaviour as it would shift the governance structure from the spot market (currently the most dominant) to a more integrated approach.

3

GOVERNANCE CHOICES BY SMALLHOLDER FARMERS IN THE PINEAPPLE SUPPLY CHAINS IN BENIN: AN APPLICATION OF TRANSACTION COST THEORY

Chapter 3: Governance choices by smallholder farmers in the pineapple supply chains in Benin: An application of transaction cost theory

3.1 Introduction

Over the past decade, pineapple production in Benin has increased more than four-fold from 50,000 tons in 2000 to 222,000 tons in 2009 (World Bank, 2010b). Production is consumed locally (35%), exported in the region (40%), and processed into juice (15%). Regional exports in dried form account for 8% and exports to the European Union for just 2% (GTZ & MAEP, 2008). It is estimated that the value of pineapple production amounted to US$25.8 Million in 2006 (4.3% of agricultural GDP and 2.1 % of total GDP), and the value chain created 15,000 direct jobs and 25,000 indirect ones. Pineapple production represents an important economic opportunity and the government recognizes its importance. Pineapple production follows a two-year cycle and requires a significant level of investment, often beyond the financial capacity of the individual smallholders. The various pineapple supply chains (PSC) (local, regional and export markets) have different forms of governance structures (usually bi- or multilateral agreements), often put in place to safeguard chain actors' investments. These governance structures range from the spot market to collective actions. Farmers choose from this portfolio of options, and are often simultaneously involved in more than supply chain – with their choices often influenced by the heterogeneous quality of their produce. As highlighted in chapter 2, there is a lack of scientific evidence on the determining factors that affecting of simple or multiple choices of governance structures. In response to this, this chapter investigates the following questions: Faced with a context of different governance structures (GS) and alternative choices, are farmers' selections independent or related?, and 2) What are the intrinsic (farm and farmers' socioeconomic characteristics) and extrinsic (enabling institutional support, market and transaction attributes) factors that affect the choices about governance structure in the pineapple supply chain?

From the perspective of transaction cost theory (TCT) a rational farmer will chose a governance structure that helps minimize production and transaction costs (Williamson, 1985). Some projects

have been established with the aim of reducing transaction costs, such as contract farming (Glover & Kusterer, 1990), cooperatives and producers' associations (Bijman & Wollni, 2008). However these have not always been successful.

Traditional economic theories, based on how the supplier seeks comparative advantage when selecting a governance structure, have significantly contributed to understanding trade at local and international levels. However these do not fully explain the multiple choices of governance structures by chain actors. The present study seeks to add to the literature by empirically and simultaneously considering how intrinsic (farm and farmers' characteristics) and extrinsic (enabling environment, transaction attributes) factors can explain farmers' choice of governance structure. The study contributes to propose a new construct, namely 'multi-governance', the simultaneous use of more than one governance structure, to deepen the understanding of how and why farmers in less developed countries select governance structures. Using transaction cost theory, the chapter seeks to explain the major reasons guiding the choice of governance structure in Benin's PSC, drawing on a broader range of explanatory factors than previous studies. The study provides empirical evidence based on transaction cost theory and the choice of governance structure. It also considers the connectedness of transactions as a determinant of governance structure choices.

3.2 Theoretical background

Transaction cost economics (TCE) is an approach to studying economic systems and organizations. TCE integrates perspectives from institutional theory, the law and economics (Rao, 2003). Coase (1937) was one of the first to explain the role of transaction costs in the theory of the firms. The main approach of TCE is, as Williamson (1989) suggested, to assign attribute to differentiated transactions in a transaction-cost-minimizing manner. Transaction costs can be broadly interpreted as the costs of planning, adapting and monitoring for compliance under alternative governance structures. North (1990) has described these as the costs of measuring the valuable attributes of what is being exchanged, the costs of protecting rights and of policing and enforcing agreements. These definitions indicate the main focus of

TCE on the institutions and the evolution of governance structures in relation to the role of transaction costs. In other words, TCE focuses on the costs involved in making transactions, rather than of producing something. The production cost for a particular task/function is the cost of performing that task, and is borne by the firm performing it. Several factors affect production costs, including; resource requirements, scale effects, and buyer experience. By contrast transaction costs are the costs required to write, monitor, and enforce the contract. These costs include the costs of running a market-based system, or the costs associated with the allocation of tasks to external agencies or outsourcing (Bello, Dant, & Lohtia, 1997). According to Williamson's transaction cost framework (Williamson, 1991) the magnitude of the transaction costs is determined by several key attributes. These include the specificity of investments, the level of uncertainty, bounded rationality and the connectedness of the transaction. Governance is viewed in terms of the design of the particular mechanisms that support an economic transaction involving an exchange of property rights. TCE tries to explain the optimal governance structure under different sets of situational contingencies (Barney & Hesterly, 2006).
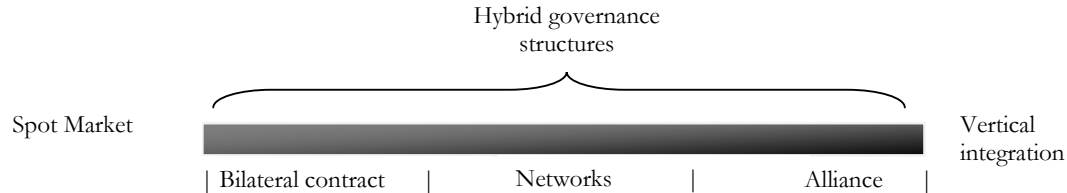
Figure 3.1: Continuum of governance structures in the chain
(Adapted from Ménard, 2004 and Pascucci, 2010)

TCE distinguishes a continuum of three major forms of governance structures, ranging from the spot-market and hybrid exchanges to vertical integration, also known as a hierarchical governance structure, (see Figure 3.1). Hybrid forms of governance structures include bilateral contracts (classical, neo-classical and relational contract arrangements), networks (collective trading, partnership) and alliances (cooperatives, join venture). Following Williamson (1985), when there is a high level of collaboration and a strong relationship between the buyer and seller the GS will

be closer to the vertical integration model. When the relationship is weaker, the GS will be closer to the spot-market mode. The TCE framework also identifies that the costs of any transaction can be broken down into *ex ante* and *ex post* costs. *Ex ante* costs such as search costs, information costs, and the costs of negotiating and developing a contract or agreement, are incurred before and during the transactions. *Ex post* costs are the costs that arise after the transactions, such as the costs of monitoring and enforcing contracts or agreements (Williamson, 1996). *Ex post* transaction costs, also known as coordination costs among organizational theorists (Douma & Schreuder, 2002), are the resources dedicated for the creation, maintenance, and use of institutions and organizations (Furubotn & Richter, 2005). Following Coase (1937), Williamson (1985) developed tools for exploring the mechanisms of governance. These contributions have been used to accumulate a significant amount of knowledge about the different structures that can support and secure transactions.

Several factors influence the choice of governance structure or the institutional arrangement between and within actors involved in a transaction. The anticipated complexity of sharing tasks among partners and coordinating across organizational boundaries is a major factor in the choice of a specific mode of governance and in the design of mechanisms for monitoring the arrangement (Gulati & Singh, 1998). However, in the literature, the influence of the institutional environment on the choice of governance structure is still unclear (J. E. Hobbs, 1997; Ménard, 2004). The number of parties to be included in the arrangement will influence the choice between bilateral and multilateral agreements, which chain actors also have to decide on. Bilateral arrangements are easier to monitor but involve more dependency; while multilateral agreements make the management of the relationship more complex, but allow comparisons and benchmarking, a powerful tool for constraining opportunism (Ménard, 2004).

North (1981, 1990, 1991) has investigated how interactions are undertaken among agents, and emphasized the importance of the rules of the game for understanding how actors play that game, choosing ways to organize transactions. Williamson (1991) went a step further, introducing the possibility of shifts in parameters that could explain changes in the mode of governance at the micro level. Based on Williamson's model, Oxley (1999) developed an econometric test, showing how the legal definition and the implementation of property rights significantly influence the choice between equity and market-based contracts in hybrid

arrangements designed for transferring technologies. Economics started with a dichotomist view between systems based on decentralized decisions and those planned from the centre, expressed in various, but similar, ways: 'markets and plans' (Coase, 1937), 'markets and hierarchies' (Williamson, 1975), 'hierarchies and polyarchies' (Sah & Stiglitz, 1986). Grandori (1997), added a third type of governance form, drawing on a range of concepts from other economists: clans (Ouchi, 1980), trust (Bradach & Eccles, 1989), democratic polyarchies (Lindblom, 1977), networks (Levacic, Mitchell, Thompson, & Frances, 1991) and many others) and constitutional ordering (Sabel, 1993). It is difficult to properly compare these categorizations with the two types of markets and hierarchies (Grandori, 1997). The growing literature on hybrid forms of governance structure, which stand between markets and hierarchies, shows the growing importance of their nature and role in a market economy. A previous study (Arinloye, Hagelaar et al., 2010) on the pineapple supply chain in Benin identified market type governance structures, and three other types of governance structure falling into the hybrid class: namely relational based GS, outgrowing schemes, and the farmers' organization.

3.3   Empirical measurement of governance structures

The governance structure indicates the type of inter-relation agreement that is used between farmers and traders. These can take different forms. They include a spot market relationship, a reputational based arrangement, an outgrowing scheme (minority holdings) and collective actions (producers' organizations). As argued before in chapter 1, these transaction arrangements cover the full range of governance structures that form a continuum between arms-length arrangements and full integration (Powell & DiMaggio, 1991; van de Vrande, Vanhaverbeke, & Duysters, 2009; Williamson, 1985). Each type of governance structure is considered as a multiple choice equation system, where farmers have a possibility to select one or more than one GS among the four possible alternatives. The following are descriptions of the different GS types in the pineapple supply chain:

A *spot market GS* is characterised by a handshake and 'one-shot', unrepeated relationship between buyer and seller (Williamson, 1985).

A *relational-based GS* is an informal form contracting based on a relationship and previous experiences between buyer and seller (Bradach & Eccles, 1989; Gibbons et al., 1994; Ménard, 2004). It can be classified as a bilateral form of governance structure (Pascucci, 2010) and implies a degree of trust in the transaction. Several authors see trust as a way to secure transactions when contracts are incomplete (Bradach & Eccles, 1989; Zucker, 1986). This reputational selection is guided by familial and/or friendship relations between both parties and the transactions are characterized by a high level of trust and commitment.

An *outgrowing scheme GS* is considered as bilateral contract farming between small farmers and processors or traders. It has the following characteristics. (1) It gives the buyer a high level of control in controlling production and harvesting practices on the farm to ensure pineapple quality. (2) It provides the farmer with a loan to buy inputs and accomplish the production on time. (3) And /or it provides inputs (growing materials, Ethephon, fertilizers, etc.) directly to farmers. ,(4) It provides training to farmers on good production practices and monitors their performance (Brüntrup & Peltzer, 2006). This type of GS is generally accomplished under short or medium term contracts (one harvest or one production cycle) and falls under marketing specification, resource-providing and product management types of contracts (Baumann, 2000). The emphasis here is on partners' monitoring and controlling the actions and decisions of others through specific and identifiable organizational devices that they have intentionally designed and agreed upon.

In a *farmers' association GS* the farmer is a member of an organization that provides all the needed assistance through (1) monitoring, (2) group selling, (3) assisting members in finding markets, and (4) social assistance. A farmers' association can more easily access extension services and financial support. This form of governance is characterized by long term contracts and is generally open-ended, lasting as long as membership of the association is valid (Wennink & Heemskerk, 2006).

3.4   Data collection and methods

3.4.1 Research model

The research model hypothesizes some factors that affect the choice of a particular chain governance structure. These include (1) the socio-economical characteristics of the actors and the firms, (2) the transaction attributes (including asset specificity, uncertainty, and the connectedness of the transactions) and (3) the institutional environment (see Figure 3.2).
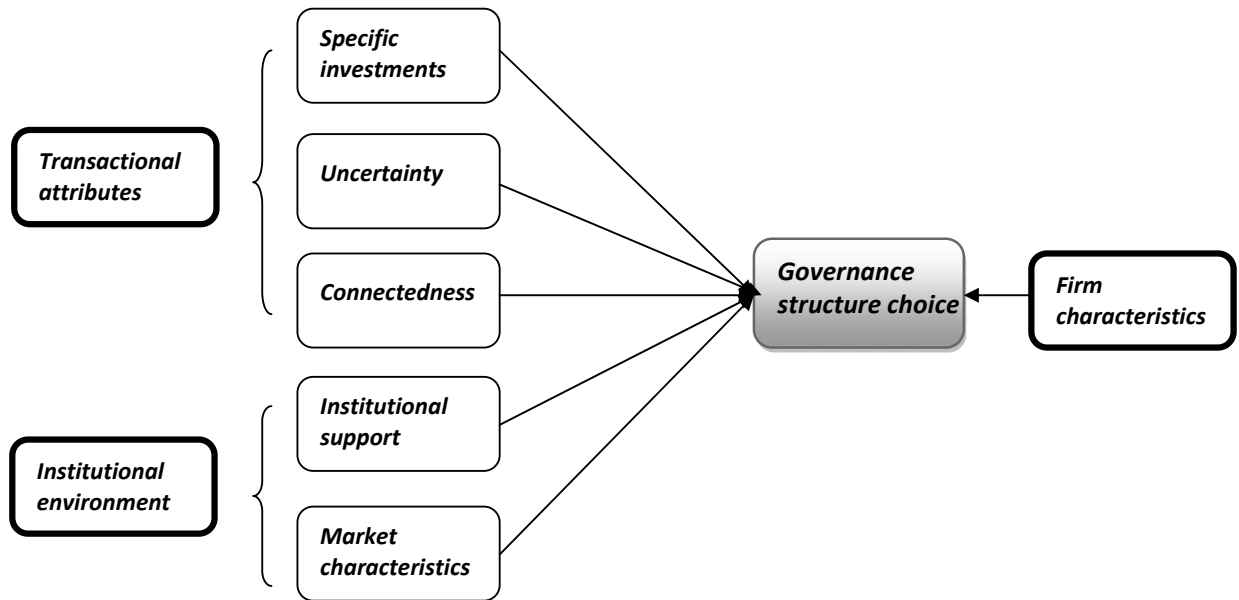
Figure 3.2: Research model

Firm characteristics

The firm characteristics[10] include the following constructs: geographical location (distance between the production area and the market), farm size (hectares), ratio of land dedicated to

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[10] Hereinafter, firm characteristics refer to farmers' socio-economical characteristics and farm attributes.

pineapple growing to the total cultivated land). Farmer's characteristics are also considered through the constructs such dynamic capabilities (i.e., capability to cope with changes in the market and environment and to satisfy customers' needs), age, trust and commitment between farmer and buyer. Farmers feel safer in a market setting where they have long-term relationships with their buyers (Lu, 2007). Moreover, on the basis of previous studies farm size was expected to influence farmers' decisions (Akinola, 1987; Polson & Spencer, 1991). This leads us to hypothesize that large scale farmers who are located far from the market place will be more likely to be involved in long-term relations and more integrated chain governance structures.

Asset specificity

Asset specificity refers to the extent to which non-fungible assets are tied to particular transactions specified by contracts or other forms of commitment (Williamson, 1985). Assets are specific to a particular use if the returns they provide are valuable only in that use, and cannot be put to any alternative use. The degree of asset specificity may be assessed in terms of the investment value that is lost when the asset is switched from its intended original use to an alternative use. According to TCE these three aspects of asset specificity have implications for firms seeking the optimal (most efficient) governance mechanisms for carrying out transactions. Williamson identified site, physical, human, temporal and dedicated asset specificity as distinct types of transaction-specific investments. This study focuses on the specificity of human and investment assets. Human asset specificity refers to relation-specific 'know-how' developed between actors involved in the transaction. As defined by Heide and John (1992), human asset specificity can include empirical knowledge specific to a particular supplier's product, or the time and effort that goes into learning about a supplier's specific requirements (Artz & Brush, 2000). Following Williamson, we used different operationalized constructs of human asset specificity: membership of a pineapple farmers' association, investment in education and experience cumulated in pineapple farming. The evidence suggest that the probability of choosing a hierarchical form of governance structure is significantly and positively influenced by a high level of human and physical specificity. When assets have a high specificity, there is a greater risk of actors facing a hold-up (non-transferability) problem. Menard (2004) stated that the likelihood of contract-based arrangements is even higher when uncertainty coincides with investments that

cannot be redeployed for another transaction. This may lead farmers to choose an integrated form of governance structure in order to protect their investment. It can therefore be assumed that the greater the human and asset specificities, the more likely it is that the actors will be involved in an integrated form of governance structure.

Uncertainty

When transactions are conducted under uncertainty, it can become very costly or impossible to anticipate all contingencies (S. D. Frank & Henderson, 1992). Under conditions of market uncertainty actors are more likely to restrict their range of exchange partners to those with whom they have had prior interactions and have transacted in the past (March, 1988; Podolny, 1994). It is therefore important to determine the types of transaction uncertainty that affect the choice of governance structure. Ruben *et al.* (2007) stated that 'central' governance is needed more when a the environment of a supply chain is uncertain in order to guarantee that objectives of all stakeholders are attained. A high level of uncertainty may discourage a supplier from making investments in specialized assets if appropriate safeguards are absent (Lu, 2007). To measure uncertainty, we used information about price stability and the quality and quantity of pineapples delivered to buyers over time. Pineapple producers may involved in contractual arrangements to produce specific labelled products (organic or Fair Trade pineapples for EU markets) that require specific investments, but may at the same time maintain other production channels, not included in the agreements, to which they can switch. When they have this capacity to reduce the uncertainties associated with the agreement, they adopt a mode of governance that is close to a spot market arrangement (Sauvee, 2000, 2002). Hence, the more uncertainty over price, quality and quantity, the more integrated the governance structure will be.

Connectedness

Transactions may be inter-connected in different ways, especially those transactions that involve making highly specific investments. It is possible that the assets or service that they yield might

be highly complementary. Some transactions are largely dependent on others and give rise to a hold-up problem and lock-in effects (Slangen, Loucks, & Slangen, 2008). An example of strong inter-connectedness is the relation between water and an irrigation system. Without water, an irrigation system is useless and also the other way around. This raises the question of property rights, ownership and the best governance structure. When the transacting parties have divergent interests, these become harder to coordinate, increasing the transaction cost. To understand the behaviour of any single supplier within a supply chain, it is necessary to look at the supplier's dependence on the dominant buyer and the their connectedness to the other network of suppliers (Cook, 1977; Provan, 1993). When the supplier is highly dependent on the buyer this strengthens their cooperation (Provan, 1993). When the transactions are strongly connected with other transactions, or occur in small batches, or over short periods of time, this will increase the coordination costs (Bogetoft & Olesen, 2004; Rindfleisch & Heide, 1997; Wood & Parr, 2005). When there is a strong connection between the transactions a strong coordination mechanism is more appropriate as this reduces the transaction costs (Meyer, Milgrom, & Roberts, 1992). The stronger the ties between buyer and seller, the higher the level of transaction connectedness will be (Wong & Chan, 1999). The present research measures the transaction connectedness with the following constructs: chain actors' awareness of the quality required by the customers of their buyers and of the price paid by them, and the connectedness of the harvesting period to the demands of traders and consumers. We assume that the higher the degree of transaction connectedness, the more likely it will be that the actors are involved in a more integrated GS.

Institutional environment

The term 'institutions' refers has a broad range of meanings which are often used ambiguously. Douglass North was one of the first scholars to link institutions and economic performance. The works of Davis and North (1971) and North (1990) shed light on how institutions affect economies and economic agents. These works distinguish between the institutional environment and institutional arrangements. The institutional environment sets the rules of the game of human interactions and the institutional arrangements are the players of the game. The institutional environment can be either formal (public, legal, governmental) or informal (social, moral). Institutions enable, constrain and direct human interactions (Nelson & Sampat, 2001).

They reduce uncertainty by setting the rules of the game and creating a stable structure to human interactions, that keeps transaction costs low. Several authors have argued that the relative importance of formal institutions increases as the scope of market exchange broadens and deepens (Dixit, 2007; M. Fafchamps, 2006). This is partly because establishing formal institutions requires high fixed costs but low marginal costs, whereas informal institutions have higher marginal costs. Examples of formal institutions can be credit institutions, property rights, constitutions, etc. Informal institutions refer to norms of behaviour, conventions, self imposed codes of conduct, reputation, etc.

In the present study, we consider the influence of an enabling institutional environment such as institutional support, good controls over agronomic practices, capacity building, quality control (norms and standards) services, market facilities, subsidies etc. and how these can influence the farmers' choice of one (or more) governance structure(s) in the pineapple supply chain.

3.4.2 Survey design

Questionnaires were elaborated to collect the data needed to assess the factors affecting the choice of governance structure in the pineapple supply chain. The questionnaires were built on the theoretical background elaborated above and information from existing studies on Benin's PSC (Arinloye, Hagelaar et al., 2010). The questionnaires were pre-tested with 10 key informants in Allada and Cotonou districts. The pre-test allowed adjusting the questionnaire to focus on the most relevant questions. In addition, the original 7-point Likert scale was changed to a 5-point scale (1=not agree at all, to 5=totally agree), to it more appropriate to the low literacy level of the people to be interviewed.

3.4.3 Data collection

Data were collected through face-to-face semi-structured interviews. The respondents were selected using the following criteria: acreage under pineapple cultivation in 2009, i.e. small scale (<1 ha), medium scale (between 1ha-5ha) and large scale (>5ha), participation in an

integrated/spot market governance regime (with and without contract, cooperation, organization, outgrowing, etc.), distance from the main urban market (located in Cotonou) and trading with exporters or regional market buyers (from Nigeria). Other factors also contributed to the selection criteria: being knowledgeable about the subject matter and willing and able to communicate with the researcher (Campbell 1955). An overview of the number of respondents per farmer category is shown in Table 3.1. The data was collected between September 2009 and July 2010.

Since more than 95% of pineapples produced in Benin come from the Atlantique Department (district), we randomly selected our respondents from this area, using a randomly stratified sampling scheme based on the above criteria,[11] Pineapple farmers were traced with the assistance of the regional agricultural extension services department which provided a list of names of farmers in each district. The second source of information on pineapple farmers were the pineapple producers' association and councils. Equally important was information from the literature review. In total 219 farmers were interviewed across Zé (rural), Abomey-Calavi (peri-urban), Allada, Toffo and Tori-Bossito (all rural) (Table 3.1).

Table 3.1: Sample sizes of each type of farmer per location

Famers categories	Locations/districts					**Total**
	Abomey-Calavi	Zè	Allada	Tori-Bossito	Toffo	
Small-scale [<1ha]	20 (9.1)	32 (14.6)	25 (11.4)	18 (8.2)	18 8.2)	*113 (*51.6)
Medium-scale [1-5ha]	19 (8.7)	19 (8.7)	17 (7.8)	12 (5.5)	13 (5.9)	*80 (*36.5)
Large-scale [>5ha]	6 (2.7)	8 (3.7)	3 (1.4)	5 (2.3)	4 (1.8)	*26 (*11.9)
Total	45 (20.5)	59 (26.9)	45 (20.5)	35 (16)	35 (16)	219 (100)

(*) percentage in brackets

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[11] Stratified sampling is commonly used probability method that is better than random sampling as it reduces sampling error. A stratum (or criteria) is a subset of the population that shares at least one common characteristic. Examples of strata are farm size or (non) - membership of a farmers' association. We first identified the relevant criteria and whether they were sufficiently well-represented in the population. 'Sufficient' here refers to a sample size large enough to give us reasonable confidence that the stratum represents the population of pineapple farmers (estimated at 4,000 in 2010)

3.4.4 Analytical approach

The study sought to explain the effects of internal and external factors (transaction attributes, social capital, the institutional environment and socio-economic characteristics) on the choice of governance structure and outlet and these two features were investigated as dependent variables.

As one actor can be involved in one or more than one type of governance structure, we found it appropriate to use a multivariate probit model to analyze the determinants of choice(s) of governance structure in Benin's pineapple supply chain. A *Multivariate probit* estimates M-equation probit models, using the maximum simulated likelihood method (Cappellari and Jenkins, 2003). The variance-covariance matrix of the cross-equation error terms has values of 1 on the leading diagonal axis, and the off-diagonal elements are the correlations that are to be estimated ($\varrho_{ji} = \varrho_{ij}$, and $\varrho_{ii} = 1$, for all i = 1,...,M). For each observation, a likelihood contribution is calculated for each replication, and the simulated likelihood contribution is the average of the values derived from all the replications. The simulated likelihood function for the sample as a whole is then maximized using standard methods. For a detailed description of this model see Greene (2003) and Train (2003).

In this model, the governance structure is considered as a system of a multiple choice equation (i=1...4; j=1,.....n) respective to each type of governance structure.

$$GoverStr_{ij} = \alpha_{0j} + \beta_{1j}TransAttrib_{ij} + \beta_{2j}\,InstEnv_{ij} + \beta_{3j}\,Caract_{ij} + \varepsilon_{ij} \quad (1)$$

Where: *GoverStr$_{ij}$* = Governance structure *i* choice by the farmer *j*

         TransAttrib$_{ij}$ = Transaction attribute *i* of the farmer *j*

         InstEnv$_{ij}$ = Institutional environment

         Caract$_{ij}$ = Farm characteristics

         ε_{ij}= Error terms and α_{ij}, = the coefficients to be estimated.

The software package STATA SE was used to estimate the empirical version of equations (1) using data gathered from the 219 respondents.

3.5   Results and discussion

3.5.1 Governance structure selection

The data collected from the 219 pineapple farmers indicates that more than 90% of them are involved in the spot market GS (Table 2) followed by the relational based GS (58%), the association GS (41%) and an outgrowing scheme (21%).

Table 3.2: Types of governance structure identified

Types of Governance Structure	Observations	Percent (%)	Std. Err.	[95% Conf. Interval]	
Spot Market	198	90.41	0.020	0.865	0.943
Relational	128	58.44	0.033	0.518	0.650
Outgrowing	47	21.46	0.028	0.160	0.269
Association	91	41.55	0.033	0.350	0.481

Table 3.3: Number of governance structures in which farmers are involved

Degree of Multi-governance	Observations	Percent (%)	Std. Err.	[95% Conf.Interval	
Farmers with 1 type of GS	44	20.09	0. 027	0.147	0.254
Farmers with 2 types of GS	111	50.68	0. 033	0.440	0.574
Farmers with 3 types of GS	58	26.48	0. 029	0.206	0.324
Farmers with 4 types of GS	6	2.74	0.011	0.006	0.049
Total	**219.00**	**100.00**			

Table 3.4: Participation in governance structures by farm size

	Total number of GS in which famer is involved				
Farm size	1	2	3	4	Total
Small<1ha	*28 (63.64)*	*67 (60.36)*	18 (31.03)	0 (0)	113 (51.6)
Medium 1-5ha	14 (31.82)	32 (28.83)	*29 (50)*	*5 (83.33)*	80 (36.53)
Large>5ha	2 (4.55)	12 (10.81)	11 (18.97)	1 (16.67)	26 (11.87)
Total	**44 (100)**	**111 (100)**	**58 (100)**	**6 (100)**	**219 (100)**

Note: Pearson Chi2 (6) = 23.9541   Pr = 0.001; (..) Column percentage in brackets

Table 3.3 summarizes the number of GSs in which farmers are involved. As indicated, most respondents (80%) are simultaneously involved in at least two types of governance structure. If a farmer is involved in more than one type of governance structures, this implies more than one exchange relationship. One governance structure is taken as equivalent to one exchange

relationship. Farmers indicated that reasons for selecting multiple governance structures were to safeguard their investments and avoid post harvest loses of pineapple fruits rejected from the international market (through weighing and sorting), and also because some buyers (urban and regional markets wholesalers) do not fulfil they agreement or promises to buy the entire farmers products when reaching the maturity.

Table 3.4 compares the farm size of respondents with the number of GS in which they are involved. This shows that most farmers with a low level of engagement with multiple GS (i.e. those involved in one or two GS) are small scale (< 1ha) producers (63% and 60% respectively) while those with more than two GS are mostly medium or large scale producers. The computed Pearson Chi2 (tested at six degrees of freedom) was used to test the differences between these farmers' categories. It shows that farm size has a significant influence on the number of chains farmers' participate in. Farmers with more land surface under pineapple production are most likely to be simultaneously engaged in 3 or 4 types of pineapple supply chain GS.

3.5.2 Determinant of governance structure choices

Prior to the regression of the multivariate probit model, a factor analysis was conducted to reduce the dimensions of the variables. Bartlett's Test of Sphericity determines whether each variable is independent, and Kaiser-Meyer-Olkin (KMO) determines the sampling adequacy (Chen & Fu, 2011). KMO takes values between 0 and 1: low values mean that overall the variables have too little in common to warrant a factor analysis. Kaiser (1974) recommends accepting values greater than 0.5 as *barely acceptable*. Values between 0.5 and 0.7 are *mediocre*, values between 0.7 and 0.8 *good*, values between 0.8 and 0.9 are *great* and values above 0.9 are *superb* (Field, 2009). According to the Kaiser criterion (1974), Eigenvalues is a good criterion for determining a factor. Factors with Eigenvalues of less than one should not be considered.

The summary of computed factor loadings, the KMO and the Eigenvalues are presented in Appendix 1. With KMO values varying between 0.6 and 0.7 we can deduct that the sampling is fairly adequate. Bartlett's Test Chi2 is significant at 1 % (p<0.01) showing that the selected

dependant variables for factors analysis are not correlated. All the selected factors have Eigenvalues greater than one, with all factors having a variance superior to 0.7 responding to the variance extraction rule "Factors with Eigenvalues less than 0.7 should not be considered". The factors analysis allowed generating the explanatory variables included in the regression model. Tables 3.5 and 3.6 present the summary statistics and the correlation matrix of the variables used in the multivariate probit regression.

The result of this econometric regression is presented in Table 3.7. The Wald test is used to examine whether any of the parameters of the model that currently have non-zero values could be set to zero without any statistically significant loss in the model's overall fit to the data ($\beta_{1i} = \beta_{2i} = \beta_{3i} = 0$). This tests the overall significance of the variables we have included in the econometric model (McGeorge et al. 1997; Ryan and Watson, 2009). The results show that the Wald Chi2 is statistically significant at the 1 percent level, indicating that the subset of coefficients of the model are jointly significant and that the explanatory power of the factors included in the model is satisfactory.

Table 3.5: Summary statistic of variables included in the regression model

Variable	Variable description	Mean	Std. Dev.	Min	Max
Farm and farmer's characteristics					
age	Age of farmer	37.174	10.724	17	73
educ	Education level	0.995	1.011	0	4
Experience	Experience in pineapple farming	9.575	5.258	1	40
Dynamic capability	Farmers Aptitude to change	0.689	0.464	0	1
Distance	Geographical position to market	3.301	1.880	0	5
Trust Comit	Trust and commitment	0.000	0.995	-2.31	1.10
FarmSize	Farm size	1.603	0.692	1	3
bargPw	Bargaining power	2.174	0.504	1	3.00
Transaction attributes					
HumInvest	Human specific investment	0.000	0.998	-0.63	4.44
PhysInvest	Asset specificity investment	0.000	0.998	-1.45	4.50
UncertBehav	Uncertain behaviour	0.000	0.995	-1.86	2.86
CertMark	Market stability	0.000	0.995	-1.60	1.78
Connectdn	Connectedness of transaction	0.000	0.995	-1.20	2.77
Market attributes					
ArgmPredf	Predefined marketing arrangement	0.000	1.000	-0.65	3.46
DeverPref	Diversification of preferences	0.000	1.000	-1.69	1.46
PermantDem	Permanente pineapple demand	0.000	1.000	-3.83	0.88
Institutional environment					
InstitSup	Institutional support	0.000	1.000	-0.91	2.16

Table 3.6: Correlation matrix of the variables used in the model

Variables	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17
Age (V1)	1.00																
Educ (V2)	0.18	1.00															
Experience (V3)	0.03	0.03	1.00														
chang_dyn (V4)	0.30	0.20	0.08	1.00													
Distanc (V5)	-0.07	-0.16	-0.06	-0.20	1.00												
TrustComit (V6)	-0.10	-0.14	-0.10	-0.28	0.27	1.00											
FarmSize (V7)	0.38	0.10	0.10	0.16	0.00	0.04	1.00										
bargPw (V8)	-0.05	0.02	0.02	0.02	-0.39	-0.12	0.00	1.00									
HumInvest (V9)	0.21	0.11	0.06	0.23	-0.33	-0.19	0.14	0.07	1.00								
PhysInvest (V10)	-0.02	-0.09	0.02	-0.08	0.62	0.19	0.14	-0.23	0.00	1.00							
UncertBehav (V11)	0.06	-0.06	-0.13	-0.02	0.36	0.27	0.12	-0.25	-0.05	0.33	1.00						
UncertMark (V12)	0.15	0.02	-0.02	0.17	-0.38	-0.12	0.06	0.18	0.29	-0.26	0.00	1.00					
Connectdn (V13)	0.10	0.03	0.03	0.17	-0.19	-0.07	0.11	0.04	0.37	-0.10	0.17	0.32	1.00				
ArgmPredf (V14)	0.19	0.17	0.00	0.12	-0.03	0.09	0.23	-0.08	0.31	0.11	0.20	0.06	0.32	1.00			
DeverPref (V15)	0.16	0.03	0.10	0.46	-0.17	-0.39	0.09	0.14	0.26	-0.07	-0.07	0.25	0.38	0.00	1.00		
PermantDem (V16)	-0.04	-0.09	-0.03	-0.21	0.58	0.11	-0.02	-0.40	-0.10	0.41	0.30	-0.21	0.10	0.00	0.00	1.00	
InstitSup (V17)	0.27	0.27	0.13	0.29	-0.14	-0.08	0.30	0.12	0.23	0.01	0.03	0.08	0.18	0.24	0.20	-0.12	1.00

Table 3.7: Multivariate probit estimation for governance structure choice

Factors description		Types of governance structures			
		Spot Market	Relational	Outgrow	Association
Transaction attributes	Human specific investment	-0.28*	0.28*	0.19	-0,12
	Asset specificity investment	0.12	0.61***	0.16	0,16
	Uncertain behaviour	0.12	-0.12	-0.09	-0,04
	Connectedness of transaction	-0.26*	-0.04	0.30**	0,31**
	Market stability	-0.13	-0.10	0.23**	-0,30*
Institutional environment	Institutional support	-0.10	-0.22	-0.22*	1,62***
Market attributes	Predefined marketing arrangement	0.34**	-0.17	0.02	0,48**
	Diversification of preferences	-0.12	0.09	-0.24*	0,00
	Permanente pineapple demand	0.14	-0.45***	0.03	0,22
Farm and farmer's characteristics	Farm size	0.08	-0.09	0.00	0,65**
	Ratio pineapple farm/total farm land	-0.01	-0.51	1.38***	-0,81
	Geographical position to market	-0.21	-0.07	0.05	0,09
	Trust and commitment	-0.26*	1.69***	0.02	0,00
	Age	0.01	0.001	0.01	0,01
	Experience in pineapple farming	0.05*	0.01	-0.03	-0,02
	Education level	0.14	0.08	0.01	0,27
	Bargaining power	0.06	0.01	-0.30	0,08
	Dynamic capability	-0.29	0.18	0.06	1,36***
Constant		1.31	0.90	-1.31*	-2.92**
$\varrho 21$			-0.14		
$\varrho 31$			-0.33**		
$\varrho 41$			0.14		
$\varrho 32$			-0.25**		
$\varrho 42$			0.07		
$\varrho 43$			-0.36**		
Number of observations			219		
Wald chi2 (df)			373.68 (76)***		
Likelihood ratio test Ho : $\varrho 21 = \varrho 31 = \varrho 41 = \varrho 32 = \varrho 42 = \varrho 43 = 0$; chi2(6) = 11.5727*					

$ P < 0.1, ** P < 0.05, and *** P < 0.01.*

The likelihood ratio test is also significant; leading us to reject the null hypothesis stating that all the ϱ (Rho) values are jointly equal to zero. This is shows the goodness-of-fit of the model. Basically, the ϱ-values explain the degree of correlation between each pair of dependant variable levels (each type of governance structure). Individually considered, we found three ϱ-values to be statistically significant. The $\varrho 31$ (correlation between the outgrowing scheme GS and the spot market), the $\varrho 32$ (correlation between the outgrowing scheme and the relational based GS) and $\varrho 43$ (correlation between the farmers' association and the outgrowing scheme) are negatively correlated and statistically significant at 5% critical level (P< 0.05). This generally implies that farmers involved in the outgrowing scheme governance structure are less likely to be involved in another type of governance as well. This shows the specificity and exclusivity of this type of transaction arrangement in the pineapple supply chain.

Looking at the factors affecting the choice of each type of governance structure, we notice that different factors determine the farmer's decision (see appendix 1 for more details on the description and the selection of methods of these factors).

First, the human specific investment is significantly and negatively correlated with the spot market GS. This shows that there is no specific investment made in the transaction under this mode of market governance, neither in the knowledge acquisition and capacity building with respect to production practices, nor when shifting to another product or buyer. This result is in line with the transaction cost theory stating that the lower the human and asset specificity, the more likely the actors are to be involved in less constraining and less integrated arrangements.

Also the specific human investment is found to be significantly and positively correlated with participation in the relational based GS. This implies that the choice of relational based governance structure, where farmers chose their buyers based on social relationships (familial and/or friendship), is determined by the farmers' capacity to invest in human assets. This may be justified as in this kind of buyer-seller relationships there is high degree of trust between the parties involved.

Transaction connectedness refers to how transactions differ in how they are connected to other transactions in the chain (see appendix 1 for more details on the factor loading for transaction connectedness). Milgrom and Roberts (1992) argued that when transactions have a strong connection, this favours strongly coordinated governance. We find a negative and statistically significant correlation between the transaction connectedness and the spot market governance structure, and a positive and significant correlation with the outgrowing scheme and farmer association type of governance structure. Transaction connectedness was measured by the farmers' awareness of the demand attributes of the customers of their buyers, which can be a trader, a processing company or an exporter. Transaction connectedness also considers the connection between a farmer's production system and agronomic practices (floral induction treatment, Ethephon application and harvesting period) and the buyer's demand attributes and quality requirements. We can infer from that result that the more farmers are engaged in a highly coordinated type of GS, the more likely they are aware of the end consumer's quality requirements, and the more they adjust their production practices to fulfil these demands. It can be inferred that a more hierarchical GS is positively correlated with transaction connectedness.

One positive and favourable indicator for choosing an outgrowing scheme is the stability and consistency of the buyer's preferences. This factor positively and significantly correlates with outgrowing scheme GS choice and negatively with farmers' association GS choice. Farmers involved in association based GS find that the quality demanded is less stable and less consistent than those involved in outgrowing schemes.

Another construct that was considered to explain the farmers' choice of a governance structure is the institutional environment in which transactions occur. Here, we considered the facilities and support received from private and public services to improve product quality and income. These include technical and financial support, training on good agronomical practices, quality norms and standards, market facilities, etc. Results show that the choice for a farmers' association governance structure is positively and significantly influenced by differences in the form of institutional assistance received by farmers. Considering the social capital and collective actions that characterise associations, the public and private sectors are most likely to support groups and associations, rather than engage in bilateral transactions, such an outgrowing scheme or a

relational based GS. Also, national agricultural development policies give more priority to assisting collective actions (association, cooperatives) than individuals.

Market attributes were also considered as a factor affecting the farmer's choice of governance structure. The indicators we used to measure the market attributes included a pre-agreed market arrangement based on price and quality specifications, and the requirements of specific production practices and the quantity by the buyer. The results show a positive significant correlation with two types of governance structure: the spot market and the associative GS. For the first one, an unexpected correlation was found. The hypothesis was that when more pre-agreements exist in market arrangements, farmers are more likely to go for an integrated type of governance structure to safeguard their investments (Williamson, 1985). However, the research findings show that within a spot market transaction arrangement, the quantity and price can be agreed at the moment and the place where the transaction takes place. It is important to note that in the pineapple supply chain, under a spot arrangement, the market agreements are generally informal (oral) without any formal written engagement. The drawback of this informal arrangement is that the transaction can unexpectedly be changed at any moment of the transaction, which generally is not the case within a farmer association GS.

We also found that a farmer's preference to be involved in several exchange relationship determines his or her choice of governance structure. The buyers in outgrowing scheme GS with farmers, show stable and less diversified requirement. This result is in line our previous result on the stability of buyer requirements over time.

As a control variable, the farmers and the farm characteristics were included in a multivariate probit model. The results show that farmers involved in an association generally have more land planted with pineapple. As these farmers are generally not only producing pineapple, the importance of pineapple production was calculated calculating the land used for pineapple cultivation as a ration to the total acreage of cultivated land. We can infer from the regression model that the farmers under the outgrowing scheme arrangement devote more of their land to pineapple production than other categories of farmers.

It was previously demonstrated that the spot market GS is characterised by less human specific investments, while the reputation based GS is characterised by a high human specific investment. The argument used was based on the degree of trust between chain actors. We used trust and commitment as variables in order to test this assumption. The findings show that the choice of relational based GS is increased by a high and significant degree of trust and commitment between the buyer and seller involved in a transaction. By contrast, spot market arrangements are made by farmers with low trust and commitment to their buyers.

Other control variables include the farmer's age, experience in pineapple farming, education level (schooling), bargaining power with the buyer, and dynamic capacity. Among these factors, the farmers' experience in pineapple production and dynamic capability (changing production practices in order to respond to the market demand) are shown to be positively significant at 10 and 5 % critical levels (see Table 3.4), for the spot market and the farmers' associations GS. This implies that the more dynamic farmers generally choose associative relationships and those with a lot of farming experience bargain under a spot market form of arrangement.

3.6   Conclusion

The transaction cost analysis provides many insights into the choice of governance structure. It suggests that all else being equal, a rational actor will chose a governance structure that performing best in minimising production and transaction costs. This study provides empirical evidence to transaction cost theory and develops Williamson's attributes of transaction by emphasising connectedness as a transaction attribute that is worth considering when analysing the choice of governance structure in less developed counties. A new construct of 'multiple-governance' structure is investigated to increase understanding of how and why farmers select among these governance structures and what guides their decisions. The multi-governance choice has been observed as a strategy of farmers for safeguarding their investments. This strategy was established to sell the different categories of product's quality to different supply chains. Farmers involved in the outgrowing scheme GS are less likely to be involved in another type of governance; showing the specificity and exclusivity of this type of transaction arrangement in the pineapple supply chain. The results, showing factors underlying the choice of each type of GS,

have a potential to be used as a tool for defining intervention strategies for promoting contract enforcement in bi - or multilateral partnerships in agrifood chains. This study does not investigate the influence of the selected GS on pineapple quality or farmers' income and created added value, which would also be important in devising policy recommendations. Further investigation should consider these aspects.

4

MARKETING CHANNEL SELECTION BY SMALLHOLDER PINEAPPLE FARMERS IN BENIN

Chapter 4: Marketing channel selection by smallholder farmers in pineapple supply chain in Benin

4.1   Introduction

According to the United Nation Millennium Development Goals, Benin, should, in common with other countries, achieve food security and reduce poverty by 50% by 2015. A key strategy to reaching this goal is to stimulate the development of new crops, such as pineapple. Over the past decade pineapple production in Benin has been growing rapidly (Adossou, 2012). Stringent quality requirements, however, mean that very little of this (circa 2% of total production) is exported to Europe (Fassinou-Hotegni, Lommen, van der Vorst, Agbossou, & Struik, 2012). Low levels of participation in such high value market channels, is a serious challenge for the Beninese (and Sub-Saharan African) agricultural sector. If the factors that affect farmer selection of different market channels were better understood then managerial and policy interventions could be implemented to support it.

Market channel selection is influenced by the nature, efficiency and costs of the processes involved in accessing markets (Obi, Pote, & Chianu, 2011). According to van Schalkwyk, *et al.* (2012), market access can be influenced by different factors. Firstly, it can be influenced by the quality, cost and timeliness of information about product availability, attributes and prices, Secondly, it can be influenced by information about transactions between different parties. A third factor is the confidence that suppliers in other actors' market conduct. Finally, the physical costs of accessing a market (which is a function of the quality of infrastructure and the transport sector); and the actual price levels found in the markets where people transact, also play a role. These factors largely coincide with IFAD's (2003) dimensions of market access: physical access to markets and distances; the structure of markets (asymmetry of power relations between farmers, market intermediaries and consumers); and the level of producers' human capital (for example to understand market forces, prices, bargaining, etc.) (see also (Blandon, Henson, & Islam, 2009). Selection of different market channels is also influenced by product quality, especially where access to market channels requires compliance with stringent standards and regulations, there is a high risk and/or buyers have much bargaining power (Dolan & Humphrey, 2000).

The literature on market channel choice has a relatively long history, with most of the work dealing with the nature of the producer-distributor relationship (Artle & Berglund, 1959; Coughlan, 1985; van Tilburg & van Schalkwyk, 2012). However, these studies have not modelled simultaneous the selection of different market channels nor did they take into account the role of product quality and suppliers' bargaining power as potential determining factors.

Smallholder farmers generally lack vertical linkages and are rarely collectively organized which, many claim, results in their exclusion from marketing channels that supply international (export) markets (Delgado, 1999; Fenwick & Lyne, 1999; Jari & Fraser, 2012; van Tilburg & van Schalkwyk, 2012; Wynne & Lyne, 2004). These observations have been mainly drawn from the South African context, and this study tests these in a different economic contexts (Benin's pineapple supply chain see Figure 4.1) where most pineapples are sold into the national and regional markets - for example to neighbouring Nigeria) which have less stringent quality and standards requirements than European markets.

In Bangladesh it has been found that the bargaining power of chain stakeholders in marketing channels can play important role in excluding smallholder farmers (Kabeer, 2002). This chapter seeks to explain the same question in the Beninese context and thereby, contribute to the literature that seeks to answer the following research question: 1) Whether or not small-scale farmers are rejected from the growing higher value and emerging regional and urban markets in Sub-Sahara Africa and the EU?, and 2) Which intrinsic and extrinsic factors affect the marketing channel selection? It thoroughly investigates the four main marketing channels for pineapples in Benin: the rural, urban, fresh export, and processing markets. Smallholder farmers struggle to get good prices for their products, and endeavour to find the best and most sustainable outlets for generating a high income. The study contributes to the literature by providing empirical evidence on pineapple farmers' decisions about market channel choices. It provides policy recommendations and discusses the implications for sustainable production and market access by smallholder farmers.

The chapter begins by describing the conceptual and theoretical frameworks of the study. We then present our data collection strategies and methods, followed by our empirical findings. The chapter ends with concluding remarks and highlights the implications for policy and practitioners.
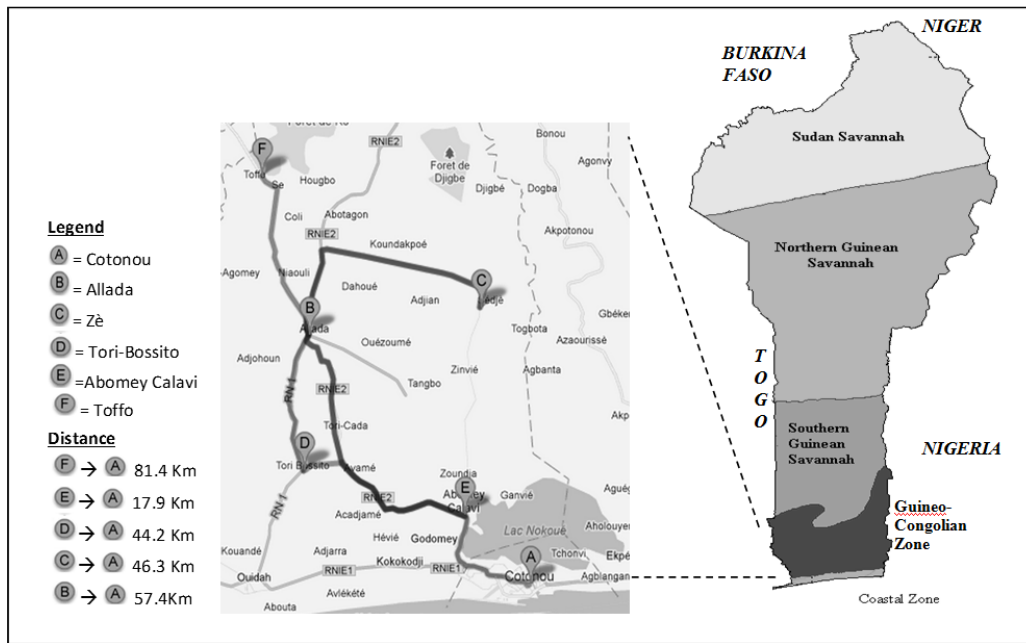
Figure 4.1: Benin's pineapple production zone, showing data collection areas and their distance to the main urban market in south Benin.

4.2   Conceptual and theoretical frameworks

4.2.1 Conceptual framework

The conceptual framework showing the factors that were considered to affect the choice of marketing channel is presented in Figure 4.2. Marketing channels are defined as the downstream part of the value chain. They contain a number of chain actors at different outlets, through to the final point of sale to consumers. Coughlan et al (2001) see these chain actors as utility-creating parties that offer end-users a combination of products and services. The literature in the field of market participation (Boughton et al., 2007; de Janvry, Fafchamps, & Sadoulet, 1991; M. Fafchamps, 1992) has explained the reasons why smallholders have a low participation rate in high value markets. This has been shown to be largely a result of low crop productivity and market failures (Benfica, Tschirley, & Boughton, 2006; Boughton et al., 2007; Dijkstra, Meulenberg, & van Tilburg, 2001; Heltberg & Tarp, 2002; van Tilburg & van Schalkwyk, 2012). Other factors affecting market participation choices include farm size (per household worker), farm assets (animal, tractor, equipment, etc.), age (or farming experience) of household head, transport ownership and available infrastructure facilities (roads, storage and conditioning). Transactional incentives can also affect chain actors' marketing decisions (Pascucci, 2010).

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A recent study in South Africa, aimed at identifying strategies for unlocking market access to smallholders, showed that factors such as poor infrastructure, lack of market transport, lack of market information, insufficient knowledge and use of grades and standards, an inability to conclude contractual agreements and poor organizational support were the main factors that led to an inefficient use of different market channels, and contributed to bottlenecks in commercialization (Jari & Fraser, 2012).

In Costa Rica, an investigation into the determinants of market outlet choice for mango producers (Zuniga-Arias & Ruben, 2007) explored four major factors. The first was related to the farm household (including the farmer's experience, trust and attitude to risk); the second concerned the production system (farm size and production scale); the third was related to price attributes; and the last was the market context (having a written contract or not, geographical location and distance to urban markets). (Blandon et al., 2009; Brewer, 2001) also found that physical distance is a main determinant of market channel selection. Producers often target nearby markets since their geographic proximity means they have more knowledge about these markets, easier access to information and lower travelling and transportation costs (Andersen & Buvik, 2002; Papadopoulos & Denis, 1988). It has also been shown that farmers' bargaining power is an important factor when they make decisions about which marketing channel to use (Kabeer, 2002; Zuniga-Arias & Ruben, 2007). This study adds to the literature, not only by testing these observations in the different context of Benin, but also by investigating how produce quality attributes, rejection rates, and contractual arrangements affect marketing decisions and how these help to explain smallholder farmers' choice of different market channels for a perishable tropical food product.
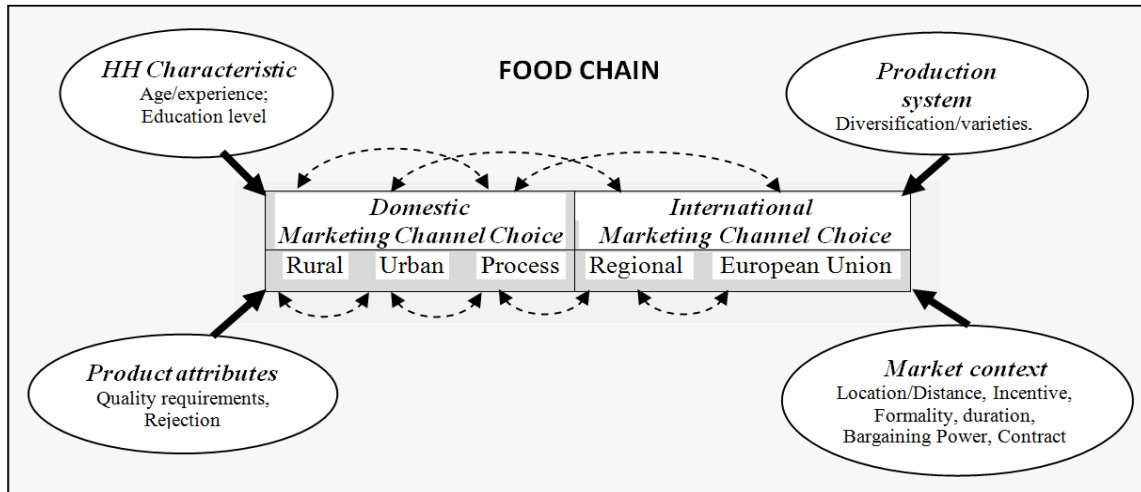
Figure 4.2: Conceptual framework of factors affecting choice of marketing channel in food chains (adapted from Zuniga-Arias & Ruben, 2007).

4.2.2 Theoretical framework and modelling

Since the 1980s many Sub-Saharan African countries have embarked on Structural Adjustment Programmes, which have aimed to open new liberalized market-oriented economic systems. Economic liberalization has given opportunities for smallholder farmers to diversify their production and take their surplus to nearby markets (Asfaw et al., 2010). Removing trade barriers and discouraging local monopolies has given smallholder farmers more choice about the best markets for inputs and their produce (B. A. Shiferaw & Teklewold, 2007). Our focus is to model smallholder farmers' market decision making process, using utility maximization theory. Economic theories used for explaining farmers' decision marking are generally rooted in utility or profit maximization theory (Griliches, 1957). Utility is explained in terms of the profits that chain actors can gain from their activities. Households can obtain different levels of profit from different contexts, and it is considered that their choice of what to produce and whom to supply is influenced by their profit prospects (Doll & Orazem, 1984).

A farmer's decision to sell in a given market is assumed to be derived from the maximization of the expected utility or profit he or she expects to gain from this market (R. H. Frank & Glass, 1991; McFadden, 1986; Salvatore, 2003). This utility is a function of a vector of factors (X_a^A), unknown parameters β_a and an error term ε, assumed to be independently N $(0, \sigma^2)$ distributed (Equation 1). Farmers' make decisions about whether or not to chose a given market by evaluating the gains in their expected utility, taking into account the related investments and

costs (Kelsey, 1994; Lazear & Rosen, 1981). It is expected that farmers' will choose the market that shows the most positive utility. The expected difference in utility is expressed as follows:

$$U_j \;\; = \left[\pi_{ij}^A - \pi_{ij}^0 \right] = X_a^A \beta_a + \; \varepsilon^A, \tag{1}$$

where U_j is the unobserved expectation operator representing the expected utility difference, π_i^A is the utility derived from market i if selected by farmer j, and π_i^0 is stream of utility if market i is not selected. Farmers make a subjective comparison of market attributes and their own capacities to meet the markets' demands. They only choose a market – rural, urban, processing or international – when it is perceived to offer a higher utility than the alternative options. From equation 1, we can infer the market selection decision model as being:

$$Y_{ij}^A = \begin{cases} 1 \;\; if \;\; [\pi_i^A - \pi_i^0] \; \geq 0 \;\;\; & \Leftrightarrow \;\; X_a^A \beta_a \geq \; -\varepsilon^A \\ 0 \;\; if \;\; [\pi_i^A - \pi_i^0] < 0 \;\;\; & \Leftrightarrow \;\; X_a^A \beta_a < \; -\varepsilon^A \end{cases} \tag{2}$$

The farmer j decision to select the market i is defined as Y_{ij}^A and the choice of farmer j to sell in market i ($Y_{ij}^A = 1$) or not ($Y_{ij}^A = 0$) is expressed as follows:

$$Y_{ij}^A = \begin{cases} 1 \;\; if \;\; Y_{ij}^A = X_{ij}^A \alpha_{ij} + \varepsilon^A \; \geq 0 \;\;\; & \Leftrightarrow \;\;\; X_{ij}^A \alpha_{ij} \geq \; -\varepsilon^A \\ 0 \;\; if \;\; Y_{ij}^A = X_{ij}^A \alpha_{ij} + \varepsilon^A \; < 0 \;\;\; & \Leftrightarrow \;\;\; X_{ij}^A \alpha_{ij} < \; -\varepsilon^A, \end{cases} \tag{3}$$

where a_{ij} is a vector of estimators, ε^A is a vector of error terms under the assumption of normal distribution, Y_{ij}^A is the dependent variables, and X_{ij}^A is the combined effects of the explanatory variables.

4.3   Data collection and methods

Data were collected in 2009 with a pre-tested, semi-structured survey questionnaire consisting of a combination of closed questions, Likert scales with a 5 point format (Allen & Seaman, 2007; Jamieson, 2004) and open questions. More than 95% of Benin's pineapples are produced in the south of the country, particularly in the Atlantic Department (Hotegni, Lommen, van der Vorst, Agbossou, & Struik, 2012). Respondents were selected from this area, using a randomly stratified

sampling scheme (StatPac, 2010), based a set of criteria. These criteria included; acreage under pineapple cultivation in 2009 (differentiated into small scale - less than 1 ha, medium scale - between 1 ha and 5 ha, and large scale - more than 5 ha), market channels supplied (rural, urban, regional, processing or EU markets), and location of the farm (distance from the main urban market in Cotonou). Farmers were contacted with the assistance of agricultural extension services agents, who provided the names and addresses of lead farmers in each commune. Secondary data were also collected from the Council of the Pineapple Farmers' Association, other institutions, and libraries. This approach gave a sample of respondents from different villages across the Atlantic Department, as illustrated in Figure 4.1 and Table 4.1.

After data collection, incomplete questionnaires were discarded This resulted in a final list of 217 respondents. Of these 217 farmers, 68 were selling through at least two market channels. The farmers were asked to name the two most important market channels for distributing pineapples. As data were independently collected for each market channel, these two one-sided data sets were merged into a combined data set with a total of 285 observations.

Because of the low representation of pineapple farmers selling pineapples directly to regional market wholesalers (n=7), observations on regional markets was merged with those of international market channels (n=29) for the econometric regressions. These marketing channels were, however, separately analyzed in the descriptive results (Tables 4.3, 4.4, and 4.5).

Table 4.1: Sample sizes of each category of farmer per location

Category of famers	*Locations/districts*					**Total**
N (%)	Abomey-Calavi	Zè	Allada	Tori-Bossito	Toffo	
Small-scale [<1ha]	7 (2.46)	10 (3.51)	8 (2.81)	6 (2.11)	7 (2.46)	38 (13.33)
Medium-scale [1 - 5ha]	26 (9.12)	21 (7.37)	14 (4.91)	29 (10.18)	25 (8.77)	115 (40.35)
Large-scale [> 5ha]	26 (9.12)	34 (11.93)	18 (6.32)	25 (8.77)	29(10.18)	132 (46.32)
Total	59 (20.7)	65 (22.81)	40 (14.04)	60 (21.05)	61 (21.4)	285 (100)

The sample includes both the first (217 farmers) and second marketing channels (68 farmers), as data was collected from both channels separately, making a total of 285 observations.

Descriptive and econometric approaches were complementarily used in the data analysis. For the descriptive statistics, the independency between the explanatory factors for each selected market

channel was tested using Pearson chi squared (χ^2). Since the results from the descriptive statistics did not allow for isolating the marginal effects of specific explanatory variables, we ran simple and multivariate probit regressions. Following empirical specification a model was deduced from Equation 3:

$$
\begin{cases}
\text{UrbMarket}_j = \alpha_{0j} + \alpha_j HHDCharact_j + \alpha_{1j} ProdSystem_j + \alpha_{2j} ProdAttrib_j + \alpha_{3j} MarkAttrib_j + \varepsilon^A \\
\text{LocMarket}_j = \beta_{0j} + \alpha_j HHDCharact_j + \beta_{1j} ProdSystem_j + \beta_{2j} ProdAttrib_j + \beta_{3j} MarkAttrib_j + \varepsilon^B \\
\text{ExpMarket}_j = \gamma_{0j} + \alpha_j HHDCharact_j + \gamma_{1j} ProdSystem_j + \delta_{2j} ProdAttrib_j + \delta_{3j} MarkAttrib_j + \varepsilon^C \\
\text{ProcMarket}_j = \theta_{0j} + \alpha_j HHDCharact_j + \theta_{1j} ProdSystem_j + \theta_{2j} ProdAttrib_j + \theta_{3j} MarkAttrib_j + \varepsilon^D,
\end{cases}
$$

(4)

where $UrbMarket_j, LocMarket_j, ExpMarket_j$ and $ProcMarket_j$ are dummy variables taking value 1 when farmer *j* selects a rural, urban, export or processing market, and 0 otherwise; $HHDCharact_j$ represents a set of the household characteristics of farmer *j*; $ProdSystem_j$ represents the production systems of farmer *j*; $ProdAttrib_j$ is the set of pineapple quality attributes supplied by farmer *j*; $MarkAttrib_j$ is the set of market attribute factors perceived by farmer *j*; α_{ij}, β_{ij}, γ_{ij} and θ_{ij} are the coefficients to be estimated, and ε represents error terms.

A correlation matrix of variables used in the regression models and a description of each variable can be found in Table 4.2. Pearson correlation coefficients were used to measure the strengths of linear association between the variables. The results show that these coefficients are globally less than 0.39, indicating weak relations, which suggest that variables are sufficiently independent to be modelled together without concerns about multicollinearity (Verbeek, 2008).

Since farmers are able to choose more than one marketing channel, there was a need to test whether there is a correlation between their different market channel selection decisions. We therefore ran two econometric models: a simple probit model with the assumption of independency in market choice decisions, and a multivariate probit model assuming a correlation and interdependence in farmers' market selection decisions. Standardized coefficients and t-tests of estimated regression models were computed for each explanatory variable using STATA SE which has a *robust* option to control for the models' robustness. The robust standard errors are shown in Tables 4.6 and 4.7.

Table 4.2: Correlation matrix, mean and standard deviation of variables

	Variables	Mean	Std. Dev	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16
Dependent variables	Urban market(V1)	0.53	0.50												
	Rural market (V2)	0.27	0.45												
	Export market (V3)	0.13	0.33												
	Processing market (V4)	0.07	0.26												
Explanatory variables	Age of HHD (V5)	38.1	10.5	1.00											
	Education level HHD (V6)	1.05	1.04	0.20	1.00										
	Farm size (V7)	2.33	0.70	-0.38	-0.11	1.00									
	Number of varieties (V8)	0.30	0.46	0.06	0.12	-0.03	1.00								
	Quality required (V9)	1.94	0.84	0.15	-0.04	-0.10	-0.11	1.00							
	Rejection (V10)	0.15	0.36	-0.03	0.06	-0.07	0.31	-0.09	1.00						
	Distance (V11)	2.01	0.65	0.06	0.22	0.02	0.36	-0.10	0.19	1.00					
	Incentive from buyers (V12)	2.18	1.02	0.39	0.26	-0.39	0.02	0.22	0.05	0.30	1.00				
	Formality of transaction (V13)	1.33	0.68	0.13	0.07	-0.22	0.03	0.23	-0.10	0.17	0.29	1.00			
	Relation duration (V14)	2.02	0.80	0.32	0.05	-0.23	0.02	0.07	0.07	0.05	0.28	0.15	1.00		
	Bargaining power (V15)	2.16	0.51	-0.07	0.01	-0.01	0.36	-0.12	0.23	0.23	-0.06	-0.06	-0.01	1.00	
	Written contract (V16)	0.14	0.34	0.10	0.10	-0.13	0.12	0.14	0.12	0.22	0.26	0.11	0.17	0.07	1.00

The following values were attributed to each variable:
(V1), (V2), (V3) and (V4) are dummy dependent variables representing market participation (1=participant, 0= non-participant)
(V5): Age of surveyed household head (years)
(V6): Education level of household head (HHD) where 0 = no education, 1 = primary school, 2 = middle school, 3 = high school, 4 = university level
(V7): Farm Size (1 = large scale >5ha; 2 = medium scale 1-5ha; 3 = small scale <1ha)
(V8): Number of varieties: (0 = one cultivar: Smooth Cayenne or Sugarloaf; 1 = both cultivars)
(V9): Quality required: 1 = low quality or "Class C"; 2 = medium quality or "Class B"; 3 = high quality or "Class A"
(V10): Having faced rejection by buyers (1 = yes)
(V11): Distance (1 = <30 Km; 2= [30 - 60 Km]; 3= >60 Km)
(V12): Incentive from buyers (1 = no incentive; 2 = low incentive; 3 = medium incentive; 4 = high incentive)
(V13): Formality degree (1= no formal/spot market; 2=low formality/reputation based; 3 = formal)
(V14): Relation duration with buyer (1 = short<5years; 2 = medium 5-10years; 3 = long-term>10years)
(V15): Bargaining Power (1 = low; 2 = medium; 3 = high)
(V16): Having a written contract with buyer (1 = yes)

4.4   Results and discussion

4.4.1 Characteristics of the marketing channels

The characteristics of the marketing channels (outlets) are shown in Figure 3. The international markets include regional (neighbouring countries) and European Union (EU) markets. These markets are characterized by higher quality and standards requirements and higher freighting costs, which increase the total transportation costs, compared to the domestic markets. The domestic markets include rural and urban markets for fresh and processed pineapple. They are mostly characterized by lower (or non-existent) quality and standards requirements, except for dried pineapples which are also targeted at EU markets. The processing factories in Benin are mostly traditional and only partly-industrialized, either processing pineapple into juice, packed in bottles (0.25 litre or 0.33 litre) or drying them. This market channel is less developed and is dominated by individual processors and farmers. The juice is mainly sold on domestic markets, while the dried pineapples are exported.

Because of time and distance, the gap between harvesting the fruit and its consumption, and the risk for fruit deterioration is much higher in international markets than domestic markets. The lack of cold chain facilities also makes freighting pineapples by sea relatively unattractive. Finally, the international market has hierarchical forms of governance structure. This implies that the transaction costs – separate from the transportation costs (Blattberg, Buesing, Peacock, & Sen, 1978; J. E. Hobbs, 1997; Teece, 1986; Williamson, 1983) in this supply chain are higher than in domestic markets. All these facts could explain the low participation rates of pineapple farmers in export markets.

4.4.2 The influence of market context

Farmers were asked to describe their bargaining powers in each of the market channels in which they participate. They were considered to have low bargaining power when the buyer is the dominant actor in price setting and a medium bargaining power when an average price is agreed after a period of bargaining between buyer and seller. When farmers have full control of the

price, they were considered to have high bargaining power in the transaction. Table 4.4 shows that more than 70% of the respondents have a medium bargaining power. Though they are not price makers in the marketing transactions, most have some opportunity to raise the prices initially proposed by the buyers. This applies to almost all the identified marketing channels – 86% in regional market, 84% with wholesalers in the urban market, 72% for the processing market and 50% with urban retailers. In the rural market channel the majority of farmers (55%) have a high bargaining power. This can be explained by the farmers' closeness to this market. In the other channels, the farmers may have to bear higher transportation costs and have to reduce their price if they cannot find buyers at the preferred price. This highlights problem of poor road infrastructure and the importance of physical distance in marketing decisions (Andersen & Buvik, 2002).

To assess the influence of physical distance on marketing channel decisions, we controlled for the farmers' geographical distribution in our sampling strategies (Table 4.1 and Figure 4.1). Most of the farmers (58%) are located between 30 and 60 km from the main urban wholesale pineapple market (Dantopka Market in Cotonou). These farmers are from Allada (57.4 km), Zè (46.3 km) and Torri-Bossito (44.2 km) communes. 21% of the farmers were selected from Abomey-Calavi commune (17.9 km from downtown Cotonou) and 21% from Toffo (81.4 km). The differentiated distance from farm to the main urban market is assumed to the affect the farmer's selection of marketing channel.

Other market attributes such as trading incentives between buyers and sellers, the complexity of transactions, the duration of the buyer-seller relationship and the existence of written contracts in the market transaction are considered in the econometric models presented in Tables 4.6 and 4.7. Table 4.4 shows that more than 86% of farmers do not have a written contract with their buyers: those who have a binding contract arrangement are mostly selling to exporters (35%) and, to a lower extent, to wholesalers in urban (14%) and rural (8%) markets. Some processing factories have started to require written contracts with their supplying farmers. In most cases, these contracts state the quantity and quality of pineapples demanded and the risks and the duration of the contract. Almost all the contracts (93%) last for a maximum of 2 years (one pineapple cropping season) if the contract is signed before starting production, and for 1 year, if it is signed during the pineapple growing period. The contract is renewed if the previous one was satisfactory

to the parties involved. The renewals of such contracts can lead to a short (< 5 years), medium (5-10 years) and long-term (>10years) transaction relationships between farmers and buyers. The data show that most pineapple farmers have at least 5 years of trading experience with their buyers (70%).

The results of the analysis show that market channel selection is significantly different between farmers, according to their bargaining power, the distance from central urban markets and the existence of contractual relationships.

4.4.3 The influence of quality attributes

The study also focuses on evaluating the influence of the (physical) quality of the pineapple on the selected marketing channel. To do this, farmers were asked to provide information about the different quality levels of their pineapples. They were asked to use the following three quality levels: class A: "high quality" or "extra" class, class B: "medium quality" and class C: "low quality". Pineapples of class A meet the standards of Codex Alimentarius (Codex-Stan, 1993) and are eligible for the EU market and supermarkets. They are characterized by a weight between 1 and 2.2 kg and are free from any physical damage and contamination (fungus attack). Class B pineapples have a medium size and weight (slightly < 1 kg) and can easily be fit in a packaging box for export. Slight defections in shape are accepted but the fruits should be free of any contamination, such as fungus. This pineapple class can also be eligible for EU markets, and can also be sold in domestic and regional markets. The last class is characterized by a very low weight (<0.7 kg), with significant defects in shape and may have some fungus attacks on the skin. Class C is mostly sold in domestic markets and to some traditional pineapple juice processing factories. This classification is mostly applicable to *Smooth cayenne* cultivar. For the *Sugarloaf* variety there are no official quality standards or norms for grading, since it is only sold to domestic and regional consumers.

On average 33% of pineapples produced are class A, 26% class B and 41% class C pineapples. This heterogeneity in the quality of the harvested products may be a result of the prevailing weather conditions and/or the different production systems used by farmers. These figures

suggest that if one wishes to improve the quality of pineapple production and thereby improve access to high value markets, there is need in capacity building and providing technical supports.

Table 4.4: Market attributes by marketing channel

Buyers in the pineapple supply chains		Retailers		Wholesalers			Exporters	Processors	Total
		Rural Market	Urban market	Rural market	Urban market	Regional market			
		N=18	N=2	N=60	N=149	N=7	N=29	N=20	N=285
1) Bargaining power of farmers (%)									
Low	N=18	5.6	0	6.7	4.7	0	3.5	25	6.3
Medium	N=202	83.3	50	38.3	83.9	85.7	72.4	55	70.9
High	N=65	11.1	50	55	11.4	14.3	24.1	20	22.8
2) Distance from farm to the central urban market (%)									
<30 Km	N=59	66.7	50	1.7	29.5	0	3.4	0	20.7
[30 - 60 Km]	N=165	27.8	50	56.7	64.4	71.4	55.2	40	57.9
>60 Km	N=61	5.5	0	41.7	6.1	28.6	41.4	60	21.4
3) Having a written contract with the buyer (%)									
No	N=246	100	100	93.3	85.9	100	65.5	80	86.3
Yes	N=39	0	0	6.7	14.1	0	34.5	20	13.7
4) Duration of relationship with the buyer (%)									
Short < 5Years	N=87	38.89	50	35	31.54	14.29	17.24	25	30.53
Medium [5-10Y]	N=104	33.33	0	33.33	40.94	42.86	24.14	35	36.49
Long term >10Y	N=94	27.78	50	31.67	27.52	42.86	58.62	40	32.98

1) Pearson *Chi2* (df=12) = 64.27 Pr = 0.000.
2) Pearson *Chi2* (df=12) = 100.29 Pr = 0.000.
3) Pearson *Chi2* (df=6) = 18.09   Pr = 0.006.
4) Pearson *Chi2* (df=12) = 14.65   Pr = 0.262.
N = Number of observations.

The results show that the class C pineapple is not accepted in the export market (Table 4.5). However – certainly because of the cheaper price – it is often preferred by wholesalers from the regional (71%), rural (55%) and urban (36%) markets. The export market remains the marketing channel with the highest quality requirements: 55.2% of class A and 44.8% of class B pineapples are sold there. Class A pineapples are also sold to some domestic and regional markets, including rural retailers (44%), urban wholesalers (39%), processing factories (30%) and some Nigerian wholesalers (14%).

Table 4.5: Quality attributes and marketing channels

Buyers in the pineapple supply chains		Retailers		Wholesalers			Export ers	Processo rs	Tota l
		Rural Market	Urban market	Rural mark et	Urban market	Region al market			
		N=18	N=2	N=60	N=149	N=7	N=29	N=20	N=2 85
1) Quality requirement in each market channel (%)									
Low Quality	N=110	38.9	50.0	55.0	36.2	71.4	0.0	50.0	41.4
Medium Quality	N= 82	16.7	50.0	38.3	24.8	14.3	44.8	20.0	26.0
High Quality	N= 93	44.4	0.0	6.7	38.9	14.3	55.2	30.0	32.6
2) Farmer has experienced rejection of produce (%)									
No	N=243	94.4	50	65	90.6	100	89.7	90	94.4
Yes	N= 42	5.6	50	35	9.4	0	10.3	10	5.6

1) Pearson *Chi2* (df=12) = 46.77 Pr = 0.000.
2) Pearson *Chi2* (df=6) = 28.18 Pr=0.000.
N = Number of observations.

Farmers were asked if they had experienced rejections in their selected marketing channels. Their answers are reported in the Table 4.5. The results indicate that only 6% of farmers have experienced rejection of their products. In general the buyers only reject pineapples that are of bad quality. This result confirms Nicklin *et al.'s,* (2006) study which found that a major barrier for sustainable market access and high income generation to smallholder farmers is their low capacity to supply uniform products (quality and quantity) as requested by foreign buyers.

4.4.4 Econometric findings on the determinants of market selection

These descriptive statistics do not allow us to isolate the marginal impact of any particular variable to explain farmer's selection of marketing channels. To identify the influence of different factors we ran econometric regressions, the outputs of these regressions are shown in Table 4.6 (simple probit model) and Table 4.7 (multivariate probit model).

Table 4.6: Simple Probit Model with the assumption of non-correlation between market channel choices

	Market channels			
Factors description	**Urban Market (V1)**	**Rural Market (V2)**	**Export Market (V3)**	**Process Market (V4)**
Household characteristics				
Age of HH (V5)	-0.03 (0.01)***	0.03 (0.01)***	0.01 (0.01)	-0.01 (0.02)
Education level HHD(V6)	-0.07 (0.09)	0.01 (0.10)	0.10 (0.10)	-0.05 (0.14)
Production system				
Farm size (V7)	-0.01 (0.14)	0.33 (0.15)**	-0.24 (0.18)	-0.36 (0.23)
Number of varieties (V8)	-0.81 (0.22)***	0.85 (0.21)***	0.09 (0.28)	-0.61 (0.37)*
Product attributes				
Quality requirement(V9)	0.20 (0.11)*	-0.29 (0.12)**	0.30 (0.15)***	-0.23 (0.19)
Rejection (V10)	-0.13 (0.27)	0.64 (0.26)**	-0.48 (0.38)	-0.72 (0.52)
Market context				
Distance (V11)	-0.65 (0.16)***	0.03 (0.16)	0.47 (0.22)**	1.23 (0.35)***
Incentive (V12)	-0.13 (0.11)	-0.05 (0.12)	0.16 (0.15)	0.48 (0.20)**
Formality (V13)	-0.50 (0.16)***	0.03 (0.18)	0.42 (0.16)***	0.07 (0.24)
Relation duration (V14)	0.01 (0.12)	-0.17 (0.12)	0.20 (0.15)	-0.17 (0.21)
Bargaining power (V15)	-0.19 (0.18)	0.40 (0.18)**	0.16 (0.24)	-0.41 (0.25)
Written contract (V16)	1.14 (0.30)***	-0.95 (0.34)***	-0.25 (0.32)	-0.16 (0.46)
Constant	3.68 (0.80)***	-3.01 (0.83)***	-4.24 (1.13)***	-2.46 (1.31)**
Number of observations	285	285	285	285
LR Chi2 (degree of freedom)	104.89 (12)***	80.96 (12)***	54.51(12)***	41.34 (12)***
Pseudo R^2	0.27	0.24	0.25	0.29
Correct prediction	78.60%	81.40%	88.42%	93.33%

(..) Robust standard errors in brackets
* Significant at 10%, ** significant at 5%, *** significant at 1%.

Looking at Table 4.6, the likelihood ratios Chi-squares (LR χ^2) of 104.8, 80.9, 54.5 and 41.3, all with p-values of less than 0.0001, tell us that each of the four models is statistically significant, that is, it fits significantly better than a model with no predictors. Table 4.7, which shows correct prediction rates of 78.6%, 81.4%, 88.4% and 93.3% shows that the models have good predictive values. The Wald chi-square statistic that was used to test for the overall significance of the variables included in the model is significant at the 1% level. This result implies that the subsets of coefficients are jointly significant and that the explanatory power of the factors included in the model is satisfactory.

The Likelihood ratio test of the null hypothesis of independency between the market channel decision ($\rho21 = \rho31 = \rho41 = \rho32 = \rho42 = \rho43 = 0$) is significant at 1%. Therefore the null hypothesis that all the ρ (Rho) values are jointly equal to zero is rejected, indicating the goodness-of-fit of the model. Hence, there are differences in market selection behaviour of the farmers, which are reflected in the likelihood ratio statistics. Separately considered, the ρ-values (ρ ij) indicate the degree of correlation between each pair of dependent variables – here each market channel. The results show that two ρ-values are statistically significant. The $\rho21$ (correlation between participation urban and rural markets) and $\rho31$ (correlation between participation in export and urban markets) are both negative and statistically significant at 1% level (Table 4.7). This finding leads us to the conclusion that farmers delivering to the urban market are less likely to deliver to the rural markets *($\rho21$)*. Equally those involved in export marketing channels are less likely to send their pineapples to the urban market *($\rho31$)*. Even though we can observe negative correlations between the other marketing channel alternatives, these correlations are not (statistically) significant.

Farmers' household characteristics also play a role in influencing participation in different market channels. The age of household head (V5) is negatively and significantly (p<0.01) correlated with urban market participation and positively and significantly correlated (p<0.01) with rural market participation. Young farmers have a preference for selling to the urban market, while the older farmers prefer rural market outlets. There are conflicting explanations about the relationship between age and decision making process in the literature. Old farmers may take their decisions more easily than young farmers, because the older farmers might have accumulated capital or a

long term relationship with their clients (in the rural market), or might have preferential access to credit due to their age, availability of land, or family size (Adegbola & Gardebroek, 2007; Sall, Norman, & Featherstone, 2000). By contrast the young farmers might have a longer planning horizon or be more willing to take risks (Zegeye et al., 2001). Age can have both a positive or negative effect on farmers' decisions, as reflected in our findings. The results also show that the age does not significantly affect the farmers' decision to sell to other markets, such as export markets or processing factories.

Another household characteristic that may affect a farmer's decision is the education level of farmer (V6). Differences in education levels (no school attendance, and attendance at primary, secondary and high schools or university) did not influence farmers' decision making. This, unexpected, result could be explained by the low number of farmers with a higher level of education. More than 70% of respondents did not reach primary school level, affecting their aptitude to access accurate and up-to-date market information and their capacity to participate in markets requiring a high level of knowledge and information on norms and standards. This result suggests a need to improve smallholder farmers' capacity and skills to increase their access and use of up-to-date production and market information systems. In Benin such efforts should focus on using local dialects and employing traditional information channels (rural radio, extension service, etc.).

The characteristics of the farmers' production system are the second set of variables that could affect market channel participation. Here, two main variables were analyzed: farm size (V7) and the number of varieties of pineapples produced (V8). We found that a positive and significant correlation between both these variables and the likelihood of targeting rural markets (Tables 4.6 and 4.7). This might be due to the high transportation costs of shipping pineapple to urban markets or the difficulty of complying with international market quality norms and standards. We found that most large scale farmers (>5ha) sold part (or all) of their harvest to rural markets. Another reason could be that in some periods of the year – especially in December and during Ramadan (the Muslim fasting period of one month) – pineapple prices on rural markets are high enough for farmers to make proper margins (and a significant income) without having to bear the high transportation costs to more remote markets.

The number of varieties produced also affected market channel participation. It significantly and negatively affected the choice of urban suppliers (at 1% critical significance) and processing factories (at 10%). This result implies that farmers who supplying these two marketing channels do not diversify their production systems but are mostly specialize in one pineapple variety, usually *Sugarloaf* (Table 4.3) since *Smooth cayenne* is mostly targeted for the international market. The results show that farmers grow both varieties for rural markets (p<0.01).

The export market is the market channel with the highest quality requirements (V9) (p<0.05) and farmers who choose to supply international markets are those who are able to comply with high quality norms and standards. Farmers with certification (Fair Trade, Organic Production, GlobalGAP) are able to sell their produce at higher prices in EU markets. However, not all of the pineapples produced under these standards are sold to international markets, because very small and very big fruits do not fit in the available packaging boxes. This could explain the positive significant relation between high quality products and the urban market channel (p<0.1), as presented in Tables 4.6 and 4.7. We also found a negative and significant correlation between participation in rural markets and higher pineapple quality. Farmers with lower quality pineapples,, especially class C, often choose to supply the rural market. As these pineapples are the lowest quality, it is not surprising that some farmers experience rejection on this market (V10), which is shown to be a significant association. It may be that farmers targeting rural markets have already faced rejections in alternative markets.

Table 4.7: Multivariate Probit Model with the assumption of correlation between market channel choices

Factors description	Urban Market (V1)	Rural Market (V2)	Export Market (V3)	Process Market (V4)
	Market channels			
Household characteristics				
Age of HHD (V5)	-0.03(0.01)***	0.03 (0.01)***	0.01 (0.01)	-0.01 (0.01)
Education level HHD (V6)	-0.08 (0.09)	0.01 (0.10)	0.14 (0.11)	-0.10 (0.11)
Production system				
Farm size (V7)	-0.01 (0.14)	0.30 (0.16)*	-0.22 (0.19)	-0.24 (0.21)
Number of varieties (V8)	-0.78(0.19)***	0.80 (0.22)***	0.19 (0.27)	-0.60 (0.36)*
Product attributes				
Quality requirement (V9)	0.20 (0.11)*	-0.28 (0.12)**	0.30 (0.14)**	-0.17 (0.19)
Rejection (V10)	-0.23 (0.24)	0.67 (0.29)**	-0.42 (0.36)	-0.54 (0.43)
Market context				
Distance (V11)	-0.61(0.17)***	0.07 (0.20)	0.41 (0.22)*	1.22 (0.31)***
Incentive (V12)	-0.12 (0.11)	0.01 (0.12)	0.18 (0.13)	0.49 (0.19)**
Formality (V13)	-0.48(0.16)***	0.02 (0.16)	0.43 (0.22)**	0.12 (0.19)
Relation duration (V14)	0.03 (0.12)	-0.16 (0.12)	0.17 (0.16)	-0.25 (0.20)
Bargaining power (V15)	-0.14 (0.17)	0.40 (0.20)**	0.14 (0.20)	-0.39 (0.26)
Written contract (V16)	1.08 (0.31)***	-0.85 (0.32)**	-0.31 (0.46)	-0.32 (0.39)
Constant	3.46 (0.77)***	-3.14 (0.75)***	-4.25 (1.12)***	-2.76 (1.16)**
$\varrho21$	-0.80 (0.12)***			
$\varrho31$	-0.55 (0.18)***			
$\varrho41$	-0.14 (0.15)			
$\varrho32$	0.12 (0.12)			
$\varrho42$	-0.04 (0.13)			
$\varrho43$	-0.08 (0.12)			
Number of observations	285			
Wald *Chi2* (degree of freedom)	414.09 (44)***			
Likelihood ratio test Ho : $\varrho21 = \varrho31 = \varrho41 = \varrho32 = \varrho42 = \varrho43 = 0$; *Chi2* (6) = 141.359***				

(..) Robust standard errors in brackets

* Significant at 10%, ** significant at 5%, *** significant at 1%.

The farmers explained these quality and rejection issues to be the result of their low awareness of the quality required by some markets, which they supply; they use production systems copied from the Ivory Coast, and not adjusting them to refelect the agro-pedological conditions (Fassinou-Hotegni et al., 2012). To successfully compete in international markets, farmers could benefit from exploring MD2 production systems, or –alternatively – or could be supported by promoting the *Sugarloaf* variety (a permanent green skinned traditional cultivar) with a high quality

and nutritional value that is still unknown in international markets. Within this process, there is a need to improve marketing services and provide up-to-date market information to enhance product quality, reduce information asymmetry and increase incomes for growers.

The last factor affecting outlet choice is the market context in which the farmer is embedded. We found that the selection of the export and processing markets was positively and significantly affected by physical distance (V11), at a level of significance of 5% and 1%, respectively. This implies that those supplying the export (including the Nigerian) market and processing factories are generally further away from the urban markets. This finding could be explained by the lack of availability of logistical facilities to access urban markets. A negative correlation between urban market participation and physical distance was also found. This means that participation in urban market - point A on Figure 1 – is negatively related to the remoteness of the farm. It can be inferred that farmers who sell their products to this market are generally closer to it - all other parameters being constant. These are mainly the farmers located in Abomey-Calavi (peri-urban Cotonou). Farmers in other locations usually receive the buyers at their farm gate or sell their pineapples to alternative markets (rural or processing).

We also investigated the effects of incentives (V12) received by farmers from their buyers in terms of gifts, financial support (in-kind or as a loan), or providing market information and technical training. These practices are common in pineapple supply chains, notably in outgrowing systems (or contract farming), where we assumed that customer loyalty may affect long-term relationships. The results show that the presence of incentives positively ($p<0.05$) affects participation in the processing market channel as well as in the export markets, but is not significant in the other two markets. The impact of the degree of formality (V13) in the buyer-seller relationship on the marketing decision was also studied. This showed a positive ($p<0.001$) correlation with participation in the international market, which in other words, is characterized by a more hierarchical form of governance structure. In contrast, the urban markets are characterized by less formal market relationships. The results also revealed that farmers only have a high level of bargaining power (V15) with rural market buyers. Overall farmers' bargaining power can only be improved if they have access to accurate marketing information, such as up-to-date market prices and quality requirements, as well as access to new varieties that will allow

them to adapt their production systems to meet market demand. Reducing information asymmetry between buyers and sellers will improve the efficiency and transparency in market channel decision making.

Unexpectedly, we noticed that buyers on urban markets are beginning to require formal written contracts (V16) similar to those used in outgrowing schemes (Arinloye *et al.*, 2012) for export markets. The observed positive relationship (p <0.01) between formality and urban marketing may be due to the buyers' attempts to safeguard their investments (credit and loans provided to the farmers) and reduce the uncertainty and possible opportunistic behaviour (cheating or free riding) that sometimes occurs among pineapple farmers who deal with several markets simultaneously.. Sometimes farmers default on agreements by selling their produce to other buyers who offer higher prices, a practice known as 'side-selling' (Suzuki, Jarvis, & Sexton, 2011). This factor is negatively correlated with the decision to choose rural markets. Finally, the models did not show that the duration of the buyer-seller relationship (V14) (whether short, medium or long term) to have any significant influence on the farmers' decision-making.

4.5   Conclusion

This Chapter has analyzed the influence of the characteristics of smallholder farmers their production systems, product quality and the marketing context on their participation in different marketing channels. The results lead us to reject the widespread assumption that smallholder famers are excluded from international markets, even though the emerging markets are mostly supplied by the medium and large-scale farmers. The results also show that some farmers diversify their production systems by growing two varieties simultaneously. This result is line with Wilson's (1986) observation that farmers can use market diversification as a protective measure. Though farmers are mostly not price-makers in fresh pineapple markets, farmers do have some bargaining power when it comes to negotiating for better prices. The results of the two econometric models show that the dependency or independency of household level marketing decisions can be empirically tested.

The empirical results also shed some light on the contemporary issue of marketing channel participation in perishable agrifood chains in West Africa, helping us to disentangle the reasons why farmers (sequentially or simultaneously) choose different marking channels. It was found that those involved in export marketing channels are less likely to send their pineapples to the urban market. Even though we observed negative correlations between some choices of marketing channel, these correlations are not (statistically) significant. This result is consistent with a market participation study in African countries (Bellemare & Barrett, 2006), which found strong evidence to support the hypothesis that sellers make their market participation and selling volume decisions sequentially rather than simultaneously. Drawing on the theory of profit maximization, this study supports the line of argument that the farmers do not actually decide about which market they sell to, but they choose to supply the market channel in which their product attributes fit in.

One important result of our analysis is that the produce of pineapple farmers, who participate in rural market channels, is mostly characterized by low quality. This is strongly related to their poor access to market information (about quality and prices), their low education levels and weak capacity to comply with international market requirements. The low level of international market participation by Benin's smallholder famers is also the result of competition – particularly with Ghana and the Ivory Coast – where farmers make more use of the newly introduced MD2 variety, developed by Fresh Del Monte in Costa Rica in 1994, (only grown experimentally in Benin). MD2 is sweeter, yellower, more consistent in quality, and smaller than the traditional varieties produced in Benin. It has rapidly become popular among western consumers and its introduction has reduced demand for the *Smooth cayenne* variety in EU markets (Suzuki et al., 2011; Vagneron, Faure, & Loeillet, 2009).

Farmers' bargaining power and their physical distance from markets were identified as major determinants of marketing channel selection. Improving the present infrastructure may help to overcome the later issue. Equally, farmer's bargaining power could be improved if they had better access affordable production and marketing information, concerning techniques for improving quality, new varieties and information on market demand and current market prices. Such information would reduce information asymmetry between chain actors and enhance efficiency

and transparency in the markets. The gaps (in time and distance) between harvesting fruit and its consumption in the international markets, are significant, especially given the lack (or inadequacy) of cold chain facilities prior to sea or air freighting. This means that fruit destined for regional and international markets is at greater risk of deterioration, compared to national markets. Policy makers and practitioners could play a useful role here by creating conducive institutional environments and implementing strategies to increase farmer's awareness and access to market information and infrastructure that could reduce post-harvest losses.

As in most less-developed countries in SSA,, Benin's smallholder farmers struggle to get good prices for their products. One way to do this is through looking for the best and the most sustainable outlets for generating a high income. This study contributes to the literature by providing empirical evidence on farmers' market channel selection decisions. We found that smallholder farmers select multiple marketing channels as a strategy to safeguard their investments and maximize their incomes in the long term. This strategy also helps them to reduce the uncertainties associated with rejections from the export markets and guarantees them market access. Smallholder farmers' ability to participate in any market channel shows that they have potential, which should be reinforced. This could be achieved through providing technical and organizational assistance and support in capacity building, access to inputs, markets, and credit, the establishment of export logistics (e.g. cold chain facilities for sea freighting). Such support would improve the sustainability of pineapple production among smallholder farmers in Benin and improve their market access. Such measures would have a similar effect in other less developed pineapple growing countries.

5

REDUCING PRICE AND QUALITY INFORMATION ASYMMETRIC: A MOBILE PHONE-BASED CONTINGENT VALUATION APPROACH

Chapter 5: Reducing price and quality information asymmetric: a mobile phone-based contingent valuation approach

5.1 Introduction

Recent trends towards higher food safety standards and stricter traceability requirements in key importing countries of agricultural products increase the information asymmetry between buyers and producers, thereby raising the bar for smallholders entering such markets due to high compliance costs (Suzuki *et al.*, 2011). Information asymmetry refers to the fact that many transactions are characterized by incomplete, imperfect or unbalanced information among the transacting parties (Claro, Zylbersztajn, & Omta, 2004; Williamson, 1985). The quality and safety attributes of agricultural produce depend on how they were grown in the field, for instance, by organic farming or by conventional farming using chemical fertilisers, pesticides and herbicides. Such information is obviously known to the farmers (male or female) but not to third parties, because the cultivation practices cannot be determined simply by looking at the final product (Mikami & Tanaka, 2008). In contrast, buyers in the markets are much better informed about market prices and their fluctuations than farmers.

This issue of information asymmetry becomes more important when there are more intermediaries (collectors, middlemen, wholesalers, and retailers) along the supply chain. If price information is distributed asymmetrically between farmers and buyers, the market for agricultural products may fail to achieve an efficient resource allocation because of moral hazard or adverse selection (Akerlof, 1970; Holmstrom, 1979; Özer & Wei, 2006; Resende-Filho & Hurley, 2012). These informational problems could be avoided if farmers had the possibility to access accurate market information, such as the current price (Mikami, 2007). Reducing the information asymmetry between farmers and buyers implies a more informed trade outcome, which in turn will increase the impact on buyers' income. When there is high information asymmetry between farmers and buyers, this generally results in low profits for the farmers (Mendelson & Tunca, 2007).

The introduction of mobile phones has brought new possibilities for people to communicate and share information, for instance, on markets and services. The impact of this development is

helping to break down the urban-rural divide in African countries. For example, in Ghana, farmers in Tamale are able to send a text message to learn about maize, pineapple and tomato prices in Accra, over 433 kilometres away. In Niger, day labourers are able to call acquaintances in Benin to find out about job opportunities without making the US$40 trip (Aker & Mbiti, 2010). In Kenya, those affected by HIV and AIDS can receive daily text messages, reminding them to take their medicines on time (Pop-Eleches *et al.*, 2011). Citizens in countries as diverse as Kenya, Nigeria and Mozambique are able to report on violent confrontations via text messages to a centralised server that is viewable, in real time, by the entire world (Aker & Mbiti, 2010).

Although the increased flow of information can potentially benefit the marketing of all kinds of crops, it has been proved that it has a larger impact on reducing information asymmetry on market prices for perishable products, the quality of which is strongly related to the freshness at the time of exchange (Kalyebara, Nkub, Byabachwezi, Kikulwe, & Edmeades, 2007; Muto & Yamano, 2009). The new flow of information made available by mobile phones in African countries can help farmers and traders by providing accurate market information, allowing them to transport and trade their perishable products quickly and to avoid spoilage. Access to information by mobile phone can also help farmers to decide whether to accept the price offered by traders by obtaining price information from other sources.

In most Sub-Saharan African (SSA) countries, the mobile phone service that provides accurate and up-to-date market information is financially supported by government, development projects, investment programs and international partners for development (Donner, 2009; Donner & Escobari, 2010; Kizito, 2011). In Mali, for instance, contracting for the provision of market information is at the national level, but with a mix of funding sources from public and private sectors (Kizito, 2011). In most cases, these services are not sustained after the development and investment programmes finish.

There is a lack of empirical evidence in the literature regarding the following questions: (1) How to overcome the market information asymmetry issue in the pineapple supply chain?, and (2) to what extent are smallholder farmers able and willing to pay a premium to get these market information services (excluding external subsidies). The answers to these questions could inform the design and viability of a Short Message Service-based (SMS) framework for efficient market information systems (MISs) that are easily accessible for smallholder farmers in less developed countries.

Much has been written on the role of information and communication technologies in Africa, with a special focus on factors that affect the spread of mobile coverage and the impact of the mobile phone use on pro-poor labour market access, employment creation and health care (Aker, 2008; Bosch, 2009; Brouwer & Brito, 2012; Buys et al., 2009; Lawson-Body et al., 2011; Maranto & Phang, 2010; Porter, 2012; Porter et al., 2012). However, most of these studies have not investigated the perceptions of subscribers and the premiums they are able and willing to pay for a mobile phone service that can supply market information to rural and peri-urban areas.

Donner (2008) and Aker and Mbiti (2010) argue that economic research on smallholders' adoption and use of mobile phones in less developed countries has been limited. The present study aims to assess farmers' willingness to use a mobile phone to supply and receive market and quality information on agricultural products, as well as to investigate the premium that they are able and willing to pay for these services.

This chapter firstly draws on an exploratory case study undertaken in Ghana – a country with many years of experience of mobile phone-based MIS management – to gain insights into smallholders' perceptions on an SMS-based MIS. The lessons learnt from Ghana were used to design a survey to investigate the premium that pineapple farmers in Benin would be willing to pay for receiving an SMS-based service detailing price (hereafter called price-SMS) and product quality information, such as standards, input and disease (hereafter called quality-SMS). The outcome of this study is used to formulate policy and development recommendations for improving smallholder pineapple farmers' market access.

The remainder of the chapter proceeds as follows. First it contrasts radical and incremental innovations in the context of mobile phone use. Second it explains the shift from traditional to modern communication systems (emphasizing the use of mobile phones as market information tools) as the population's dynamic capability. Third it presents the analytical framework, models and hypothesis, and explain the methods used for data collection and analysis. Fourth, it presents the major findings and lessons learnt from Ghana and the major findings of the econometric analysis of farmers' willingness to pay for price-SMS and quality-SMS in Benin. Finally the last section discusses implementation strategies and the implications for policy and practitioners.

5.2   Theoretical framework

5.2.1 Innovation theory: incremental vs. radical innovations

Radical innovations are related to discontinuous events or major changes at the level of applied knowledge. Such innovations can turn out to be extremely important in creating new products or expansions into new markets. By contrast, incremental innovations are characterized by the improvement and continuous adaption of existing knowledge or practices (Bhaskaran, 2006; Dewar & Dutton, 1986; Ettlie, Bridges, & O'keefe, 1984; Nord & Tucker, 1987; Stefik & Stefik, 2004). Although innovations, such as communication technologies sometimes involve a discontinuous shift, most of the time such innovations occur incrementally (Tidd, Bessant, & Pavitt, 2005). Technological innovations are rarely based on radical discoveries. Many of the innovations relevant to African agriculture derive from incremental improvements in processes, products, inputs, or equipment that adapt existing technologies to the local environment in ways that enhance productivity and lower costs.

The ability to adapt involves technological empowerment and upgrading, which can lead to demand-driven knowledge generation amongst actors, as opposed to replicating the successes of other regions without taking local conditions into account. Process innovation is mainly about optimizing and getting more out of already-existing practices. The literature on innovations suggests that cumulative gains in efficiency are often much greater and more sustainable than those that come from occasional radical changes (Bunduchi & Berar, 2007; Humphrey, 2003; Raymond, Bergeron, & Rivard, 1998; Tidd & Hull, 2006). The aptitude of the agricultural innovation system to access, apply and diffuse knowledge about improved agricultural technologies is largely reliant on the presence of an enabling framework and institutional environment that supports strengthens technological capabilities by linking and promoting new income generating practices.

It is obvious that a certain degree of technological effort and investments are needed in order to sustain technology. The cost and effort involved may be substantial, and generally requires some degree of existing technologies and innovation capabilities on the part of the recipients or beneficiaries, including a basic ability to learn and understand the technology. There is also a risk involved in adopting a technology that requires an investment before the return on the investment is known, and that the user may prove unable to successfully apply the technology

(Xia & Xia, 2008). The innovation addressed in the present study, mobile phones, are already used by many farmers in rural areas, and this has cost benefits and may increase farmers' willingness to use it as a channel to access market information at a reasonable and affordable price. An adaption of mobile phone use could help solving the persistent problem of market information asymmetry in rural and peri-urban areas. This could be considered as an incremental innovation, with the possibility of increasing the incomes of farmers in SSA through using an already widespread communication tool.

5.2.2 Dynamic capabilities: from traditional to modern communication systems

Dynamic capabilities are defined as the ability to sense and seize new opportunities, to reconfigure and protect knowledge assets, competencies and complementary assets and technologies to achieve sustainable competitive advantage (Teece *et al.*, 1997). This ability involves continuous adaptation, integrating and reconfiguring internal and external skills, resources and functional competencies to match the requirements of a changing environment and consumers' needs (Helfat & Peteraf, 2009; Wang & Ahmed, 2007).

In the area of information and communication technologies, there are observable changes in generational behaviour in developing countries, showing a potential for the acceptance and adaption of new market information diffusion systems such as price-SMS and quality-SMS. From the literature, we can distinguish three generations of communication systems: the traditional, the contemporary and the modern. Studies on traditional communication systems in African countries mostly characterize them as dominated by illiteracy and a strong reliance on unwritten communication (D. Wilson, 1987; Yankah, 1989). Generally the traditional communication systems involve news reporters, correspondents, newsagents, messengers (emissaries), spokesmen (or women), envoys (ambassadors), contact-men, couriers, postmen, broadcasters, heralds, town criers, traditional emissary newsmen and theatre workshops (D. Wilson, 1987). These traditional communication systems still today provide many of the information needs of rural areas, which represent over 70% of the population. In SSA, traditional communication systems remain a trusted source of information, which is being complemented with newly introduced information and communication technologies. They remain a continuous source of

information, entertainment and education, used in societies that have not been seriously dislocated by western culture or other external influences, as is the case in many parts of the world.

The second generation of communication systems has played a major role in diffusing information to rural communities, and has much more potential. This generation includes communication media such as television, radio, printed material, video, films, slides, pictures, drama, dance, folklore, group discussions, meetings, exhibitions and demonstrations. These media have been (and still are) used to speed up the flow of information, not only in African countries but over the whole word. This generation of communication media has been used very successfully in less developed countries, and rural radio has played a particularly important role in delivering agricultural messages, weather and market information (Munyua, 2000a, 2000b).

The latest generation of communication systems includes e-business, the mobile phone and computer-based information and communication technologies (ICT) (Anandaraja, Sriram, Kathiresan, Sebastian, & Vadivel, 2009; Horikawa, Takeno, & Sugawara, 2008; Krishna Reddy & Ankaiah, 2005; Parikh, Patel, & Schwartzman, 2007; Teoh, Low, & Raphael, 2008). Access to, and use of, mobile telephony in SSA has increased dramatically over the past decade. From 2000 to 2010, the proportion of inhabitants having a mobile phone subscription rose from 0.8% to 79.9% in Benin, and 0.7% to 71.5% in Ghana. Mobile phone subscriptions in SSA increased by 49% annually between 2002 and 2007, compared with 17% per year in Europe. The population covered by a mobile phone network reached almost 77% in Ghana, and 90% in Benin in 2010 (World Bank, 2010b; World Bank & ITU, 2012). This spread of mobile phones has significantly contributed to a reduction in communication costs, allowing individuals and firms to send and obtain information on a variety of economic, social and political topics very quickly and cheaply. Several studies have shown that the reduction in communication costs associated with mobile phones has induced significant economic benefits, by improving agricultural and labour market efficiency and producer and consumer welfare in (Aker, 2008; Jensen, 2007; Klonner, Goethe, & Nolen, 2008). Mobile phones are evolving from simple first generation communication tools into service delivery platforms. This is changing perceptions about the development potential of mobile phones: from a technology that simply reduces communication and coordination costs to one that can transform lives through innovative applications and services.

5.3   Data collection and methods

5.3.1 Analytical framework

Contingent valuation (CV) is a survey method generally used to place monetary values on products or services for which market prices do not exist or do not reflect their social value. Respondents are presented with a hypothetical but realistic scenario and questions are asked about the maximum amount of money they would be willing to pay (WTP) for an amelioration of the status quo, or the minimum amount they would be willing to accept to compensate for a deterioration of the status quo (Carson et al., 2003; Ouma, Obare, & Staal, 2003). According to economic theory, when confronted with a possible choice between two or more bundles of goods, agents have preferences for one bundle over another (Carson, Flores, & Mitchell, 1999; Mitchell & Carson, 1993). This is because economic agents seek to maximize their overall level of satisfaction or utility (Carson et al., 2003; Ouma et al., 2003). These assumptions have important implications for the CV approach. From the utility function, the probability that a respondent will give a positive answer to a proposed change – i.e. start using his or her mobile phone for receiving and sending market information – is based on the probability that their utility will be greater than at present. This can be summarized using the following equation:

$$Pi_{(fully\ agree)} = Pr\{\bar{U}_{i1} + \varepsilon_{i1} \geq \bar{U}_{i0} + \varepsilon_{i0}\} \qquad (1)$$
$$= Pr\{\bar{U}_{i1} - \bar{U}_{i0} \geq \varepsilon_{i0} - \varepsilon_{i1}\}$$

Alternatively, the probability that the respondent will disagree (and prefer the status quo) is represented as follows:

$$Pi_{(quo)} \qquad = Pr\{\bar{U}_{i1} + \varepsilon_{i1} < \bar{U}_{i0} + \varepsilon_{i0}\} \qquad (2)$$
$$= Pr\{\bar{U}_{i1} - \bar{U}_{i0} < \varepsilon_{i0} - \varepsilon_{i1}\},$$

where $Pi_{(fully\ agree)}$ stands for the probability that the respondent *i* fully agrees to pay for the proposed change and $Pi_{(quo)}$ the probability that he will prefer the status quo. $\bar{U}_{i0}$, represents the respondent's total utility at the reference level (*i.e.*, status quo where he has not started using the offered service). $\bar{U}_{i1}$ stands for the *ex-ante (*foreseen) utility of the respondent if he accepts the proposed change. ε_{i0} ε_{i1} are error terms.

The CV method was initially developed in the environmental economics to assess the value of intangible items. It has subsequently been used in a variety of situations to provide a guideline for setting a price for an intangible good or service (Carson, 2000; Carson et al., 1999; Carson et al., 2003). Drawing from the existing literature, CV was found appropriate to addressing the multiple level ordered responses of pineapple farmers willing to pay for mobile phone-based market information. Such a multiple level CV, using an ordered approach, has been used in different fields of research. Very few applications (Caspary & O'Connor, 2003; Oduh, 2012) were found in the domain of MIS applied to modern communication technologies – such as by mobile phone – in agrifood sectors in less developed countries where there is strong information asymmetry. The present research contributes to filling this gap.

5.3.2 Research models

The analytical framework used in the present study is built around three complementary methods of econometric modelling. We first estimated the determinants of mobile use (using a probit model to take selection bias into account). In the second stage the factors relevant to explaining farmers' willingness to pay for MIS were assessed, using an Ordered Probit model. Finally the extent to which farmers are ready to pay an affordable price for this service was estimated using a Censured Tobit model approach. This section presents a detailed explanation of each of these analytical approaches.

In general, the endogeneity issue related to the difficulty of disentangling the effect of using a mobile phone (or not) on the willingness to pay for a MIS is a key determinant in the analytical framework. Hence, rejecting the null hypothesis by observing the significance of the explanatory variables in the model may not imply any causality in terms of farmers' effective WTP. A third driver – the use of a mobile phone – may also affect the dependent variables, inducing a spurious correlation and a selection bias that may lead to erroneous conclusions. The presence of this bias can be tested for by including a sample selection term in the regression. To take account of a possible sample bias that may be related to the inclusion or not of mobile phone users in the model, we first ran a Probit model to generate the inverse Mill's ratio (IMR) (Greene, 2008; Verbeek, 2008), which was later on included in the Ordered Probit and Tobit models.

For the Probit model, we define the dependent variable as a dummy with a value of 1 if the farmer has an operating mobile phone and 0 if not. Following White (2004) this leads to a 'selection equation' presented as follows:

$$Z_{ij}^* = \gamma_{0i} + \gamma_{ij} \sum W_{ij} + \mu_j , \qquad (3)$$

where Z_{ij}^* is a variable defining whether the farmer has already access to (and uses) a mobile phone or not, and W_{ij} presents a set of explanatory variables. The Inverse Mill's Ratio (IMR) is then generated from the parameter estimates of the probit regression of equation (3).

In the second step, using only the observations of farmers who have and use this technology, and including the IMR as a dependent variable, we estimated the WTP Ordered Probit (equation 6) and the Tobit (equation 7) models.

For the WTP Ordered Probit, the general analytical framework consists of the following equation:

$$Y_{ij} = \alpha_{0i} + \sum \alpha_{ij} X_{ij} + \varepsilon_j , \qquad (4)$$

where Y_{ij} is the target dependent variable (with 5 level Likert scale responses), X_{ij} is a set of control and dependent variables and ε_j is a vector of error terms. More specifically, the null hypothesis is that all the slope coefficients of the explanatory factors (X_{ij}) are equal to zero ($H_{0:}$ $\alpha_{ij} = 0$). The basic assumption is that a farmer will only express a WTP if he has an operational mobile phone.

While $Y_{ij} = s$ (with s = 1-5) implies that the equation has been precisely measured, there exists an unobservable (latent) variable Y_{ij}^*, such that $\eta_{s-1} \leq Y_{ij} < \eta_s$ with s = 1-5. Following Verbeke and Ward (2006), farmers' WTP for the mobile phone-based MIS is expressed as follows:

$$Y_{ij} = \begin{cases} 1 \Rightarrow \text{strongly disagree} & \Rightarrow \text{if } \eta_0 = -\infty \leq Y_{ij}^* < \eta_1 \\ 2 \Rightarrow \text{disagree} & \Rightarrow \text{if } \eta_1 \leq Y_{ij}^* < \eta_2 \\ 3 \Rightarrow \text{indifferent} & \Rightarrow \text{if } \eta_2 \leq Y_{ij}^* < \eta_3 \\ 4 \Rightarrow \text{agree} & \Rightarrow \text{if } \eta_3 \leq Y_{ij}^* < \eta_4 \\ 5 \Rightarrow \text{strongly agree} & \Rightarrow \text{if } \eta_4 \leq Y_{ij}^* < \eta_5 \end{cases} \qquad (5)$$

The variable Y_{ij} is observed only when Z_{ij}^* is larger than zero (equation 3). Hence, the expected farmers' WTP, premised upon the possession of a working mobile phone in the Ordered Probit model is expressed as:

$$E(Y_{ij}|Z_{ij}^* > 0) = \alpha_{0i} + \alpha_{ij} \sum X_{ij} + \sigma_{ij} \frac{\emptyset(X_i^P \alpha_i)}{\Phi(X_i^P \alpha_i)} + \varepsilon_j , \qquad (6)$$

Where $\emptyset$ is the probability density function of a univariate normal distribution and Φ is the cumulative distribution function. The term $\emptyset(X_i^P \alpha_i)/\Phi(X_i^P \alpha_i)$ is the IMR.

To assess if the WTP for mobile-based MIS was sufficiently, high farmers were asked the amount of money they would be willing to spend to get that service. If they did not express a WTP of any premium, the measure of desire is zero (Paolisso, Hallman, Haddad, & Regmi, 2001). Following Maddala and Lahiri (2006), the estimated Tobit model is expressed as follows:

$$E(\pi_{ij}|Z_{ij}^* > 0) = \beta_{ij} \sum X_{ij} + \sigma_{ij} \frac{\emptyset(X_i^P \alpha_i)}{\Phi(X_i^P \alpha_i)} + \varepsilon_j , \qquad (7)$$

where π_{ij} is the amount of money i that farmer j is ready to pay to get or supply market information using a mobile phone (assuming current possession of an operational mobile phone) $(Z_{ij}^* > 0)$, X_{ij} is the set of explanatory variables that are hypothesized to affect the amount that farmer j is willing to pay, β_{ij} is the parameter to be estimated and ε_j the error terms' vector.

If the IMR has a significant coefficient in both equations 6 and 7, this means that running the regression models without differentiating between farmers who are using a mobile phone from those who are not – as a basic condition – would have led to selection bias. Before running the econometric models, each variable was checked for normality using Skewness and Kurtosis tests D'agostino *et al.*, 1990).

From the literature, several factors (X_{ij}) are hypothesized as affecting farmers' willingness to adopt innovations (Adegbola & Gardebroek, 2007; Adesina, Mbila, Nkamleu, & Endamana, 2000; Adesina & Zinnah, 1993; Binam, Tonyè, Nyambi, & Akoa, 2004; Feder, Just, & Zilberman, 1985; Herath & Takeya, 2003; Sall et al., 2000). These factors include socio-economic characteristics, such as age, farming experience and income or profit (Adegbola & Gardebroek, 2007; Adesina & Zinnah, 1993; Arinloye, Adegbola, Biaou, & Coulibaly, 2010). The farmers' dynamic capability, *i.e.* their aptitude to be flexible in response to the market and environment changes, is also a determinant (Clark & Fujimoto, 1991; Wang & Ahmed, 2007; Woiceshyn & Daellenbach, 2005). The awareness level, which is determined by contact frequency with extension agents and support received or membership of an association, has also been found to significantly affect farmers' willingness to change (Adegbola & Gardebroek, 2007). The institutional environment and market context in which farmers are embedded, also determine their decisions about whether or not to adopt a new technology (Adegbola & Gardebroek, 2007; Thangata & Alavalapati, 2003). Detailed descriptions of these variables as included in the models and the hypothesized coefficient signs are presented in Table 5.1.

Table 5.1: Description of variables and hypothesized signs

Variables	Description	Value	Hypothesis [a]
Dependent variables			
Use mobile phone	Do you have/use a mobile phone?	1 = yes; 0 =no	
WTP price info SMS	Are you willing to pay for sending/receiving marketing information (price, offers) via SMS?	1= strongly disagree; 2= disagree; 3=indifferent; 4=agree; 5=strongly agree	
WTP quality info SMS	Are you willing to pay for sending/receiving quality information (standards, input and disease) via SMS?	1= strongly disagree; 2= disagree; 3=indifferent; 4=agree; 5=strongly agree	
Premium for quality info	How much are you willing to pay for quality information (standards, input and disease) via SMS?	Continue (FCFA/month)[b]	
Premium for price info	How much are willing to pay to send/receive pineapple information (price, offers) via SMS?	Continue (FCFA/month) [b]	
Independent variables			
Socio-economic and farm characteristics			
Age	Farmer's age	Continuous	+/-
Education	Education level of farmer	0= no (in)formal education; 1=primary school/informal literacy; 2=middle school, 3=high school, 4=university level	+
Experience	Years in pineapple farming	Continue	+
Dynamic capability	Have you ever changed your farming practices in response to market or environment changes to satisfy your buyers?	1 = yes; 0 =no	+
Profit margin	What was your pineapple production profit margin for the last cropping campaign (000 FCFA)[c] ?	0= < 0 FCFA; 1=]0-100[; 2=[100-500[; 3=[500-1000[; 4=[1000-5000[;5= > 5000	+
Farm size	Pineapple farm size in hectare	1= large scale (>5ha); 2=medium scale (1-5)ha; 3=small scale (<1ha)	+
Pineapple ratio	Proportion of pineapple land over the total covered land size – farm specialization	Continue [0-1]	+/-
Market Attributes			+
Info-time	Time spent to get reliable market information	Number of days	+
Distance	Distance from farm to the central urban market	1 = <30 km; 2= [30 - 60 km]; 3= >60 Km	-
Bargaining power	Bargaining power of the farmer with buyers	1=Low; 2=Medium; 3=High	-
Market channel			
Local market	Selling pineapple to local markets	1 = Local market; 0 = Otherwise	-
Export market	Selling pineapple to export markets	1 = Export market; 0 = Otherwise	+
Institutional support			
Public support	Contact with public extension agents	1 = Yes; 0 =No	+
Market support	Receiving support to access market (selling)	1= strongly disagree; 2= disagree; 3=indifferent; 4=agree; 5=strongly agree	+
Quality support	Receiving support for pineapple quality improvement	1= strongly disagree; 2= disagree; 3=indifferent; 4=agree; 5=strongly agree	+
Farming support	Receiving support for farming systems improvement	1= strongly disagree; 2= disagree; 3=indifferent; 4=agree; 5=strongly agree	+
Input support	Receiving support to access inputs	1= strongly disagree; 2= disagree; 3=indifferent; 4=agree; 5=strongly agree	+

[a] Expected correlation with dependent variables.

[b] Price in FCFA/month is generated by asking farmers the amount they are willing to pay per SMS times the frequency of sending/receiving SMS in a month. The threshold of total amount per month is fixed during the survey at a maximum of 4000 FCFA ($US 7.96) following World Bank (2010).

[c] $US1= 502 FCFA during data collection in 2009

5.3.3 Data collection

Data used in this study were collected in two phases. First, an exploratory case study (Yin, 1994) was undertaken in Ghana, predominantly to understand Ghanaian experiences in managing market information with smallholder farmers using mobile phone SMS, and to learn how subscribers perceive and appreciate this innovation in the agrifood sector. During this case study, 45 key informants were interviewed using a non-structured protocol. Those key informants included farmers and farmers' organization leaders (25), as well as 20 market support and quality control services agents. Lessons leant from Ghana were used to design a survey in Benin on price-SMS and quality-SMS willingness to pay.

In Benin, data were collected with a pre-tested, semi-structured survey questionnaire, which consisted of a combination of closed questions, Likert scales with a 5 point format (Allen & Seaman, 2007; Jamieson, 2004) and open questions. Figure 5.1 shows the mobile phone network of one mobile phone operator (MTN[©]) in Benin in 2012. It shows that most of the subscribers are located in southern Benin where our study was undertaken. From the literature (Arinloye, Hagelaar et al., 2010; Arinloye et al., 2012) we know that more than 95% of pineapples produced in Benin are from southern Benin, in particular the Atlantique Department. Respondents were selected from this area, using a randomly stratified sampling scheme (StatPac, 2010). The criteria used were the acreage under pineapple cultivation in 2009, (differentiated into small scale (<1 ha), medium scale (between 1 ha-5 ha) and large scale (>5 ha)), the supplied market channels (local or export markets), the location of the pineapple farm (*i.e.* distance to the main market centre in Cotonou, see Figure 5.1) and the support of extension agents. Farmers were contacted with the assistance of the agricultural extension services agents, who provided the names and addresses of lead farmers in the villages where they intervene. The second source of information on pineapple farmers was the pineapple producers' association and councils.

After data collection, incomplete questionnaires and non-qualifying respondents (*i.e.* farmers who did not provide accurate information) were eliminated, resulting in a final list of 285 observations. For data analysis we combined both descriptive and econometric approaches.
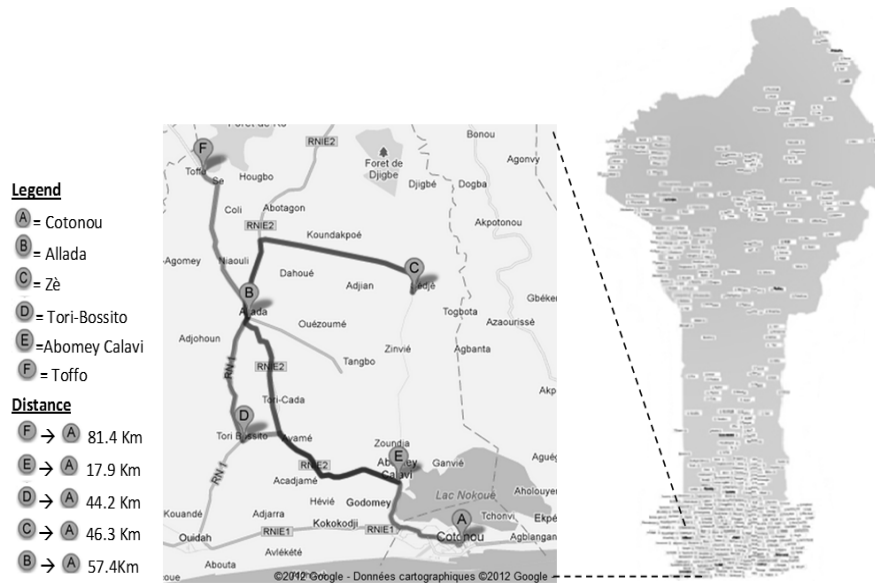
Figure 5.1: Mobile phone network in Benin with study areas, and distance to the main urban market in the south of the country (Adapted from MTN-Benin, 2012).

To design the WTP questions and assess the premium that farmers are willing to pay, we set a maximum affordable amount in order to avoid exaggerated and uncontrolled answers from respondents. The amount that was fixed, was based on a World Bank survey (World Bank, 2010b), that estimated the affordable tariff for a prepaid mobile phone to be $US 8 per month in the sub-region. This served as a reference to fix the maximum premium threshold at 4000 FCFA ($US 7.96) per month.

A correlation matrix and the descriptive statistics of the variables included in the models are presented in Table 5.2. The table shows the Pearson correlation coefficients, which measure the strengths of the linear association between variables. According to the results, the correlation coefficients are less than 0.4, generally indicating weak relations (Peters, Covello, & McCallum, 1997). This clearly shows that the variables are sufficiently independent to be modelled without multicollinearity problems (Verbeek, 2008). We used STATA SE software, which also controlled for the models' robustness – using the *robust* option. The Robust standard errors are reported in Tables 5.3 and 5.4.

Table 5.2: Correlation matrix and descriptive statistics of variables

Variable	Unit	Min	Max	Mean	Std. Dev.	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16
Dependent variables																					
Use mobile phone	(0-1)[a]	0	1	0.87	0.34																
WTP price info SMS	(1-5)[b]	1	5	4.4	1.22																
WTP quality info SMS	(1-5)[b]	1	5	4.27	1.28																
Premium for quality info	Number	0	4000	1268	1137																
Premium for price info	Number	0	4000	1200	1109																
Independent variables																					
Age (V1)	Number	2.83	4.29	3.6	0.28	1															
Education (V2)	(0-4)[b]	0	4	1.05	1.04	0.21	1															
Experience (V3)	Year	2	40	9.99	5.08	0.46	0.03	1														
Dynamic capability (V4)	(0-1)	0	1	0.72	0.45	0.33	0.23	0.3	1													
Profit margin (V5)	FCFA[c]	0	5	2.29	1.07	0.33	0.28	0.37	0.31	1												
Farm size (V6)	Ha	1	3	2.33	0.7	-0.4	-0.11	-0.26	-0.16	-0.4	1											
Pineapple farm ratio (V7)	Number	0.02	1	0.46	0.27	-0.04	-0.13	0.02	-0.01	0.24	-0.4	1										
Info-time (V8)	Number	1	30	1.66	2.39	0.03	-0.07	0.08	0.12	0	-0.07	-0.07	1									
Distance (V9)	Number	17.9	81.4	49.98	21.1	0.07	0.22	0.05	0.27	0.26	0.02	-0.06	-0.07	1								
Bargaining power (V10)	(0-1)[a]	0	1	0.13	0.33	-0.05	0.01	0.08	0.06	0.13	-0.01	0.09	0.01	0.18	1							
Local market (V11)	(0-1)[a]	0	1	0.27	0.45	0.09	0.05	0.01	0.12	-0.02	0.08	-0.15	-0.04	0.09	0.26	1						
Public support (V12)	(0-1)[a]	0	1	0.3	0.46	0.21	0.06	0.06	0.19	0.23	-0.17	0.02	-0.02	0.32	0.16	0.25	1					
Market support (V13)	(1-5)[b]	1	5	2.37	1.31	-0.25	-0.06	-0.05	-0.07	-0.13	0.2	-0.06	-0.07	0.05	0.03	-0.08	-0.46	1				
Quality support (V14)	(1-5)[b]	1	5	3.6	1.26	0.17	0.08	0.2	0.13	0.34	-0.19	0.07	-0.1	0.16	-0.03	-0.08	0	0.06	1			
Farming support (V15)	(1-5)[b]	1	5	3.96	1.11	0.32	0.16	0.29	0.22	0.38	-0.34	0.05	0.04	0.16	0.12	0.01	0.38	-0.35	0.43	1		
Input support (V16)	(1-5)[b]	1	5	2.4	1.25	-0.22	-0.08	-0.11	-0.19	-0.18	0.09	-0.08	-0.02	-0.14	-0.03	0.01	-0.08	0.34	-0.26	-0.24	1

[a] Dummy variables.
[b] Categorial variable.
[c] $US1= 502 FCFA during data collection period.

5.4 Results and discussion

5.4.1 Mobile phone-based MIS experiences in Ghana: Esoko case study

The exploratory case study in Ghana was aimed at gaining insights into smallholders' perceptions about an existing SMS-based market information system. Esoko – formerly known as TradeNet – is an agricultural market information platform created in 2006 with the objective to disseminate useful market information to smallholder farmers in less developed countries. The organization is active in 16 East and West African countries including Ghana (Esoko, 2012). It is a response to the explosive growth of mobile services in Africa. Esoko is a private initiative based in Accra, Ghana, supported by a team of over 60 local developers and support staff. Although the knowledge that farmers have is often underestimated, there exists an asymmetry of information throughout agriculture, which unfairly rewards some and excludes others. To overcome this situation, Esoko assists smallholder farmers by providing them with a package of weekly advisory services including current market prices, matching bids and offers, weather forecasts, and news and tips (Figure 5.2).

How does the Esoko platform help Ghanaian farmers? When questioned, farmers answered that the SMS services help them to improve their price negotiation capacities, find alternative markets, and enable them to sell timely at better prices. The platform provides automatic and personalized price alerts, buy and sell offers, bulk SMS messaging and stock counts. Transaction costs for farmers and traders have decreased by $ 2 – $ 150 per transaction by significantly reducing the role of middlemen to the most necessary ones or cutting them out of the transactions. This service has transformed mobile phones into a market bulletins and increased their utilities beyond voice and text. It has succeeded mainly because it allows text messages to be sent and received in several languages, including local languages, and provides real-time commodity prices. Mobile phone applications include the provision of market information and electronic trading platforms, where farmers and traders can access information on commodities being (or to be) sold, their prices, the identity of their buyers and extension service messages.

Like all businesses, farming is based on having the right information at the right time. Farmers need to know what crops to plant to obtain the best return on their investment of time and money. Ghanaian farmers have shown interest in using their mobile phones to get a good yield, and in accessing the appropriate fertilizers and pesticides to apply to their crops. SMS-based market information is also helpful for buyers who sometimes have no information about what is growing where and in what quantity. Esoko has been able to respond to this demand by providing accurate and updated prices, offers and profiles. This data can be accessed by any mobile phone user anywhere in the country covered by the mobile phone network. SMS alerts are sent out either as-they-happen (offers to buy and sell) or on specific days of the week (prices), depending on the subscriber's preference. For farmers, text messages by phone were helpful in reducing costs for searching for information and significantly reduced information asymmetry and misunderstandings with their buyers.

However, the major challenge expressed by illiterate farmers was that they always have to ask the assistance of their children or neighbours to help them to read or send messages. In rural areas this is sometimes coupled with a lack of infrastructure, such as electricity to charge phones.

Figure 5.2: Market price reception and offer in Ghana (Adapted from Esoko, 2012).

5.4.2 Information asymmetry and importance of mobile phone use by smallholder pineapple farmers in Benin

As stated in the introduction, market information asymmetry is a major factor affecting farmers' income in agri-food chains. Information asymmetry refers to transactions that are characterized by incomplete, imperfect or unbalanced information among the transacting parties (Claro et al., 2004; Williamson, 1985). As evidence, the price of pineapple at the farm gate is generally very low compared to the price at which it is sold to consumers, even in the same area. For example, our investigation shows that the price of forty medium-sized pineapples of the *Smooth cayenne* variety (*i.e.*, about 50 kg) varies between 2500 FCFA ($US 5) and 9000 FCFA ($US 18) at different periods on the local market, and can even reach 10,000 FCFA ($US 20) during the Ramadan, the fasting period of Muslims, when demand is high. Farmers on average only receive 3500 FCFA ($US 7) of this. Medium and large-sized pineapples of the second variety, *Sugarloaf,* were sold to consumers on local markets for prices between 1500 FCFA ($US 3) and 4500 FCFA ($US 9) and this can reach 8000 FCFA ($US 16) during Ramadan, while the average farm-gate price is 2200 FCFA ($US 4.3) for about 40 kg. This shows how variable and unstable the market price can be in the same location. Farmers confessed not to being aware of the prices at which traders resell their products. For instance, in the survey area, more than 86% of farmers have no knowledge of the third buyer's price of their products. According to them, the market prices remain an unrevealed confidential secret of the traders. The other 14% of famers who are (indirectly) informed about traders' market prices, either get the information by travelling to these markets to sell other agricultural products, such as maize, cowpea, cassava, etc., or by calling their relatives on these markets. This information asymmetry issue is reinforced by their low bargaining power in pineapple transactions (Arinloye *et al.*, 2012). The consequence is that farmers do not know what pineapple farmers in other villages were paid.

As witnessed in Ghana, an SMS-based platform that provides farmers with up-to-date market prices and also asks questions and receives answers from a remote computer-based platform could be a solution to these problems. This will allow farmers to have more information and therefore more bargaining power in their transactions with traders. This platform can match farmers' queries with a database of information about prices in local, urban and regional markets and send answers back to the farmers. Critical market information, such as price, offers,

inventories, questions and answers about diseases, can be uploaded and shared through SMS by anyone with a mobile phone. The present study in Benin has shed light on farmers' responsiveness to a mobile phone based MIS.

First of all, it is important to know the proportion of smallholder farmers who have and are currently using a mobile phone as a communication tool in the study area. Our result shows that the use of mobile phone is widespread in the rural areas in Benin as reflected by the sample of pineapple farmers. On average, 87% of the sample use a mobile phone (Table 2), a value which does not differ much from the subscription proportion (80%) in SSA (World Bank & ITU, 2012). This can be explained by the increasing network coverage in rural areas. As shown in Figure 5.1, the population covered by Benin's five service providers (MTN[©], Moov[©], BBCom[©], Libercom[©], and Glo[©]), in 2010 was estimated to be 90%, much higher than in SSA in 2009 when it was estimated at 53% (World Bank, 2011; World Bank & ITU, 2012). Several factors can explain this high mobile phone adoption rate: falling communication costs (Sey, 2010), population density, increasing per capita income, and, especially, competition among mobile phone operators (as demonstrated by several authors (Aker, 2008; Aker & Mbiti, 2010; Demirhan, Jacob, & Raghunathan, 2006; Lin, Li, & Whinston, 2011).

In general, most pineapple farmers were positive about using their mobile phone to access and supply market information (4.4 on a 5 point scale). In other words, farmers (strongly) agreed about using their mobile for receiving and supplying market prices, and offering their products to potential buyers all over SSA (at least in the countries covered by Esoko). Farmers also expressed a high level of interest (4.3 on a 5 point scale) in using this tool to get information that could help them improving their product quality and meeting market standards, such as information on agricultural practices, input supply, quality control and questions/answers on disease control.

The descriptive statistics (Table 5.2) show that farmers are generally willing to pay an average premium of 1268 FCFA ($US 2.5) per month to get price-SMS and almost the same average price (1200 FCFA ~ $US 2.4) to receive quality-SMS. This shows that farmers are equally interested in both product price and product quality information.

5.4.3 Farmers' willingness to pay for a mobile-based MIS in Benin

As presented in Table 5.3, the inverse Mills' ratio was not significant for the WTP for either the price-SMS, or quality-SMS. This implies that there was no need to consider selection bias issues by including users and non-users of mobile phone in the models. In other words, both current and potential mobile phone users were highly interested in paying to get and supply information via SMS. The Wald test examines whether any of the parameters of the model that currently have non-zero values could be set to zero without any statistically significant loss in the model's overall goodness of fit ($\alpha_{1j} = \alpha_{2j} = \alpha_{3j} = \cdots = \alpha_{ij} = 0$). It tests the overall significance of the variables included in the econometric models (McGeorge, Crawford, & Kelly, 1997; Ryan & Watson, 2009). Results show that the Wald Chi2 is statistically significant at the 1% level, which indicates that the set of coefficients of the model are jointly significant and that the explanatory power of the factors included in the model is satisfactory.

Determinants of mobile phone use

The Probit model of the determinants of mobile use shows that farmers' age, education level, profit margin, farm size, distance to the urban centre and contact frequency with public extension service agents, are significantly correlated with the mobile phone usage in Benin. Among these factors, education level, profit, and contact frequency with extension service agents showed a positive correlation with the adoption at a 1% significance level. In other words, farmers who use a mobile phone are mostly have a higher education level, higher farming profit margins and more frequent contact with the extension service.

Table 5.3: Probit and Ordered Probit models output.

Variables		Use of Phone (PROBIT)	WTP quality-SMS (OPRIBIT)	WTP price-SMS (OPRIBIT)
Socio-economic and farm characteristics	Age	-0.03 (0.01)**	-0.02 (0.01)	-0.02 (0.01)*
	Education level	0.78 (0.19)***	0.05 (0.08)	0.08 (0.09)
	Farming experience	0.02 (0.03)	0.02 (0.02)	0.03 (0.03)
	Dynamic capability	0.32 (0.28)	0.27 (0.29)	0.01 (0.30)
	Profit margin	0.46 (0.18)***	-0.20 (0.13)	-0.28 (0.15)**
	Farm size	-0.99 (0.34) ***	-0.31 (0.18)*	-0.40 (0.20**
	Ratio pineapple farm	-1.12 (0.55)	-0.25 (0.42)	-0.43 (0.46)
Market attributes	Information Time	0.01 (0.05)	0.02 (0.03)	0.01 (0.03)
	Distance	-0.01 (0.01)*	0.01 (0.01)***	-0.01 (0.01)
Market channels	Export market	0.25 (0.54)	0.15 (0.31)	0.23 (0.35)
	Local market	-0.06 (0.30)	-0.60 (0.18)***	-0.48 (0.19)**
Institutional support	Public support	1.63 (0.55)***	-0.57 (0.21)***	-0.55 (0.22)**
	Market support	0.16 (0.14)	-0.06 (0.07)	-0.04 (0.08)
	Quality support	0.35 (0.16)	0.24 (0.06)***	0.23 (0.08)***
	Farming support	-0.29 (0.19)	0.02 (0.08)	0.06 (0.09)
	Input support	-0.28 (0.14)	0.08 (0.07)	-0.04 (0.08)
	Constant	4.10 (1.59)	-	-
Inverse Mill's Ratio (IMR)		-	-0.85 (1.81)	-1.59 (1.98)
Observations		285	247	247
Wald chi2(df)		53.4(16)***	90.51 (17)***	53.46 (17)***
Pseudo R2		0.38	0.14	0.12
Log pseudolikelihood		-69.14	-212.93	-181.32

(..) Robust standard errors are in bracket.
* Significant at 10%, ** significant at 5%, *** significant at 1%.

The results also show that mobile phone users are mostly younger, located close to the main roads and urban centres and produce on small-sized farms. These findings are in line with our hypothesis and add to the existing literature, especially the publications of Buys *et al.* (2009) and Aker and Mbiti (2010), who have found that the mobile network coverage probability is positively related to income per capita, closeness to the main urban centres and to the main road. Most of the mobile phone users are smallholder farmers, which does not come as a surprise since 88% of the farmers produce pineapple on less than 5 hectares (Arinloye *et al.*, 2012).

Determinants of farmers' WTP for quality-SMS and price-SMS

The results of the econometric model of the factors that affect farmers' WTP for SMS based-quality showed that farmers who are most likely to pay for these services are smallholder famers, located far from the urban centre (Cotonou), mostly trading with buyers coming from urban markets, and having little contact with the agricultural extension service (Table 5.3). In most of the cases these farmers have either received technical support for on-farm quality improvement from their buyers or from Non-Governmental Organizations (NGOs). In fact, most farmers selling to exporters and some urban wholesalers have specific contracting farming arrangements with their buyers (the outgrowing scheme, Arinloye et *al.*, 2012), who provide technical or financial assistance in terms of training, input supply and loans to support the outgrowers and help them to meet their specific quality requirements. We can therefore conclude that those who are highly interested in quality-SMS, are farmers with past experiences of having received capacity building or training on product quality improvement and who are aware of the importance of product quality in the supply chain.

Apart from the distance to the urban centre, all the factors that affect farmers' WTP for quality-SMS also significantly affect the WTP to pay for price-SMS, with the same coefficient signs. This implies that farmers who are willing to pay for these services are also smallholder famers, located far from the urban centre, not trading with local market traders but with those coming from urban or regional areas, having little contact with agricultural extension services and receiving technical support for on-farm quality improvement from their buyers. Additionally, they are mostly smallholder farmers with lower farming profit margins ($p < .05$) than the average pineapple profit in the study area, which is estimated at 400,000 FCFA ($US 795) per cropping campaign.

Premium to be paid for quality-SMS and price-SMS

Since the results from the Probit and Ordered Probit models presented so far do not allow isolating the marginal effects of each explanatory variable associated with the expected premium (amount) to be paid for both services, we ran a Censored Tobit regression. The goal was to

determine how much each set of regressors, such as socio-economic characteristics, market attributes, marketing channels and intuitional support received, accounts for farmers' WTP (Table 4).

Here also, the IMR are not significant, implying that there was no need to consider selection bias issues in the Tobit models. Results show that the F statistics are statically significant at the 1% level indicating that the subsets of coefficients of the model are jointly significant and the explanatory power of the factors included in the model is satisfactory.

The marginal effect of the factors included in both Tobit models and their significance level are presented in Table 5.4. In terms of socio-economic characteristics, an increase in farmers' age by one year would decrease the premium they are ready to pay by 28 FCFA ($US 0.05) per month for quality-SMS and by 36 FCFA ($US 0.07) per month for price-SMS. This confirms the result of the ordered probit model of WTP, which indicated that younger farmers are more willing to pay a higher price than older and experienced farmers. Apparently they are also inclined to pay a higher price for price-SMS than for quality-SMS. This can be explained by young farmers having a longer planning horizon and being more willing to take risks (Zegeye *et al.*, 2001). Moreover, farmers who showed a dynamic capability (*e.g.* having changed their farming practices in response to market and environmental changes to meet their buyers' requirements in the last five years) are willing to pay an additional premium of 371 FCFA ($US 0.74) per month for quality-SMS and even more (394 FCFA ~ $US 0.78 per month) for price-SMS than farmers who showed less dynamic capability. As for the farm size, we found that a reduction of the covered land by one hectare led to an increase of the accepted premium of 183 FCFA ($US 0.36) per month for quality-SMS. The pineapple farm ratio indicates farmers' cropping diversification (or specialization). The results showed that an increase of diversity by 1% leads to an increase of the acceptable premium of 867 FCFA ($US 1.73) per month for quality-SMS.

Table 5.4: Marginal effects after Tobit models for expected premium to be paid (in FCFA) for quality and price SMS.

Variables		Premium for quality-SMS	Premium for price-SMS
Socio-economic and firm characteristics	Age	-28.0 (8.5)***	-35.8 (8.9)***
	Education level	-6.7 (65.8)	-44.8 (63.9)
	Farming experience	1.2 (15.6)	18.1 (17.1)
	Dynamic capability	370.9 (166.7)**	394.2 (166.4)**
	Profit margin	-183.3 (90.5)**	-80.5 (83.4)
	Farm size	-183.3 (155.9)***	-181.8 (150.1)
	Pineapple farm ratio	-867.1 (282.7)***	-187.2 (332.1)
Market attributes	Information Time	22.4 (26.2)	25.5(19.4)
	Distance	-5.1 (3.7)	-14.8 (3.2)***
Market channels	Export market	43.9 (232.7)	403.9 (213.4)
	Local market	12.5 (157.2)	44.1 (167.9)
Institutional support	Public support	536.1 (179.6)***	256.9 (153.4)*
	Market support	58.2 (49.8)	73.6 (48.5)
	Quality support	330.1 (68.2)***	131.7 (65.4)**
	Farming support	-23.7 (90.9)	75.2 (66.7)
	Input support	-3.1 (57.8)	25.5(55.1)
Inverse Mill's Ratio (IMR)		1523.1 (1297.6)	2747.1 (1750.9)
Observations		247	234
F statistic (df1; df2)		4.9 (17; 230)***	4.13 (17;217)***
Log pseudolikelihood		-1849.1	-1730.6

(..) Robust standard errors are in bracket.
* Significant at 10%, ** significant at 5%, *** significant at 1%.

When looking at the market attribute factors, an increase of the distance between farm and main market centre by 1 km, decreases the premium that farmers would be willing to pay for price-SMS by 15 FCFA ($US 0.03) per month. As far as the institutional support factors are concerned, farmers having regular contact with extension agents showed an interest in paying a higher premium of 536 FCFA ($US 1.06) per month for quality-SMS and 257 FCFA ($US 0.51) per month for price-SMS compared to those who do not have this contact. Moreover, farmers who have received support for quality improvement of their products would pay an additional premium of 330 FCFA ($US 0.65) per month for quality-SMS and 132 FCFA ($US 0.26) per month for price and offer SMS compared to those without any quality support experience.

5.4.4 Towards a successful and sustainable mobile-based MIS in Benin

Even when mobile phones can enhance access to resources and information, they cannot replace investments in public goods such as roads, power and water. In the absence of a proper infrastructure, smallholder farmers will face problems with efficiency and competitiveness (Roberts & Grover, 2012). As such, it is unrealistic to rely on improved access to market information access as the only strategy for improving chain performance by smallholder farmers. Such an approach needs to be embedded in an enabling political and institutional environment. Poor infrastructure remains an obstacle to the development of many, communities. Markets with a surplus are often unaware of where there is a deficit (and vice versa). Over the last twenty years the Beninese government -through ONASA (Office National d'Appui à la Sécurité Alimentaire) and INSAE (Institut National de Statisque et de l'Analyse Economique du Bénin) - has been collecting information from markets, but has not created the channels to deliver this information to the public in general and farmers, particularly not at a speed to make it commercially valuable. Implementing this mobile-based MIS, while simultaneously improving related infrastructures, may significantly contribute to helping rural communities to improve their livelihoods by achieving a better product quality and facilitating market access at national and continental levels.

Such recommendations have been made by several authors (Cavatassi et al., 2011; Mwesige, 2010; Thiele et al., 2011; Thiele et al., 2009), who call for a multi-stakeholder platform (Figure 5.3) that will strengthen public and private actors' partnerships and enable smallholders to gain sustainable access to high income markets. The private sector should provide platform coordination and management staff (like Esoko), important value chain actors (such as representatives of farmers' organizations) and a mobile phone operator to serve as the intermediary between subscribers and the computer-based platform. The public sector could provide support through existing national statistical and market information management institutes (for monitoring the collection of and profiling market information) and research institutes and quality control services (to provide reliable answers to chain actors' requests on quality, inputs, and diseases). It should also provide support services that monitor and build the capacity of smallholders and the infrastructure facilities that they need – such as rural roads, packaging and cooling facilities, finance, etc. As suggested by White (2004), this would create an enabling environment for innovation and help

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deliver the resources required to build a complex multidimensional and dynamic range of knowledge, skills, actors, institutions and policy within specific political-policy structures capable of transforming knowledge into useful processes, products and services for agriculture. These recommendations should serve as a guideline for policy-makers and practitioners.
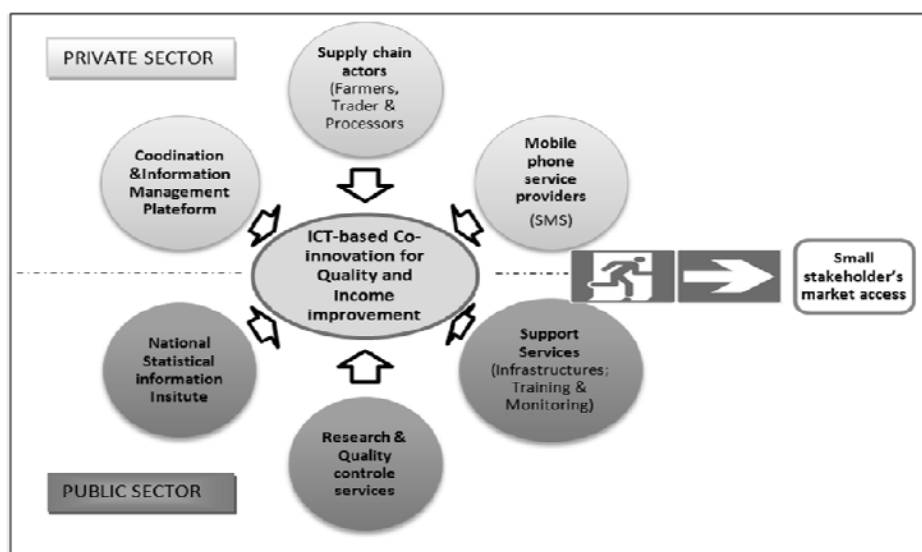
Figure 5.3: Multi-stakeholder platform for ICT-based co-innovation and market access (Adapted from CORAF/WECARD, 2011).

5.5 Conclusion

The present study assesses the determinants of farmers' willingness to use a mobile phone to supply and receive market and quality information on agricultural products, and the premium they are able and willing to pay for these services. This would be a useful strategy for overcoming information asymmetry in the pineapple supply chain. Using an exploratory case study in Ghana to gain insights into smallholders' perceptions about SMS-based market information systems, followed by an in-depth survey in Benin, the results showed that the high potential of mobile phones to improve smallholder agriculture in rural areas of SSA. In Ghana, and other countries were Esoko is active, such a system allows farmers to get market information at the right time. This study provides a better understand of the direct value of ICT in facilitating trading networks, and, most importantly, the maintenance of product quality by saving transport and market search

time. It shows how this reduces the number of unnecessary intermediaries. A proper MIS based on the use of mobile phones can also contribute to significantly reduce market information asymmetry among value chain actors. Lessons learnt from this case study may be of great importance in developing and promoting agri-food quality conservation and market access, not only in Benin but also across SSA countries that face the same challenges.

Even though farmers in the survey have shown a high willingness to pay for a mobile phone-based MIS, it remains important to assess how the existing infrastructure and institutional organizations can support such a process. This offers opportunities for future development and policy-oriented research.

6

GENERAL DISCUSSION AND IMPLICATIONS

Chapter 6: General discussion and implications

6.1 Introduction
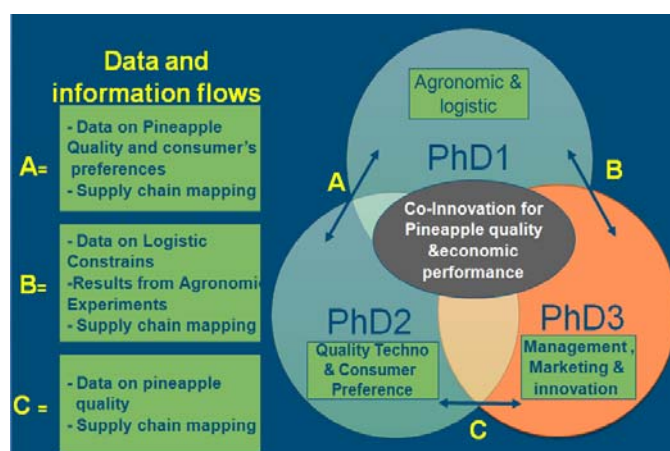
Figure 6.1: CoQA PhDs' interlinks and overall achievement

In the introduction chapter, this study is already presented as one of the studies within the Benin part of the Co-innovation for Quality in Africa (CoQA) program. The central aim of the Benin part of the CoQa program is to be able to design interventions which contribute to streamlining the supply chain and ultimately improving pine apple quality, by executing an integral analysis of co-innovation and quality management in the pineapple supply chain in Benin. Thus, the three PhD projects encompassed the whole supply chain, from farm level up to and including the consumer. The analysis of constraints and the design of solutions were drawn at three domains: agronomy and logistics (PhD$_1$), processing technology and consumers preferences (PhD$_2$), and management, marketing and innovation (PhD$_3$). PhD$_1$ aimed at using agronomical and logistical tools to improve the flowering synchronisation, quality and uniformity of pineapple in Benin produced for local and international markets. PhD2 aimed at processing and marketing of pineapple from the perspective of quality performance in the pineapple chain. This study (PhD$_3$) aimed at contributing to create value-adding co-innovations for improving access to local-, regional- and export markets. The basic idea behind this integrative approach is the acknowledgement that the quality of certain food is the result of the efforts and decisions made by all involved supply chain actors. So, when quality problems are to be addressed they need to studied and dealt with from a supply chain perspective. A quality improvement e.g. downstream can have an influence on activities upstream the supply chain. As problems cut right across the borders of any subject matter or discipline (Popper, 1963), the idea behind this integrative and

multidisciplinary research was to insure that problems are approached from different angles and to avoid one-sided solutions to the issues related to quality and market access along the supply chain. To reach these goals, the Beninese CoQA PhDs have intensively cooperated to align data collection strategies to increase consistency and reliability of the data and developed a joint understanding of the whole supply chain. Although the PhDs have different disciplinary backgrounds, the chain mapping was realized by continuous information and data flow on quality criteria and metrics, resulting in a shared language and combined results. More specifically, PhD_1 and PhD_2 exchanged information related to quality and consumer preferences which resulted in the design of a field experiment in order to incorporate consumers' quality preferences into farmers' agronomic practices. Information related to logistics, organizational structures and facilities, market information and ultimately smallholders' agronomic practices and production systems, were shared between PhD_1 and PhD_3. Pineapple quality attributes, processing techniques and market norms and standards were shared between PhD_2 and PhD_3 (see Figure 6.1). This integrated supply chain approach to quality of pineapples materialized in the linkage between the different PhD projects as well as in the framing of the object of study within each research project itself.

The objective of the present study was to identify and characterize the governance structure (GS) of the pineapple supply chain in Benin, smallholder farmers' participation in different marketing channels and to explore innovative mechanisms to overcome market information asymmetry in this supply chain. The study has used a transaction cost theory perspective to examine the relationships between the different chain actors, the constraints and opportunities they face and their strategies for improving their product quality and market access. This chapter discusses the main results and draws the main conclusions of this study. The key findings and answers to research questions are discussed in section 6.2. The theoretical contributions and implications to generalized knowledge are presented in section 6.3, while the section 6.4 presents the methodological contributions of the study. The limitations of the study and suggestions for further research are described in section 6.5. The final section discusses the policy and managerial implications.

6.2 Key findings and answers to the research questions

The organization of this thesis follows the line of reasoning derived from the main goal of the study, which was to identify an innovative approach that could help smallholder farmers to overcome market quality and price information asymmetry and improve market access. First of all, there is a need to understand the whole supply chain organisation. In order to do so the following two research questions are answered.

1) What linkages exist in Benin's pineapple supply chain (technical advice, access to finance, gifts, knowledge and information) and how do these affect pineapple quality and farmers' access to more profitable markets?
2) What are the barriers to smallholder farmers' access to profitable markets and which endogenous governance structure(s) is/are established by actors to overcome these barriers?

To answer these questions a cartography of the supply chain was drawn and it was found that pineapple quality and thereby farmers' potential access to high income markets are significantly constrained by several factors. Financial access for investment is one of the major constraints. Pineapple production follows a two-year cycle and it requires an initial investment of around $US 4,500 to produce one hectare of pineapple, far above the financial capacity of most of small-scale farmers. Personal savings, familial or friend relationships are the main financial sources used. There is lack of incentive for collective actions and group selling. The study suggests that smallholder farmers can realize scale efficiencies through collective actions, which can help them to produce according to international standards, providing them with access to new markets and potentially substantial premiums. Most small-scale producers remain unaware of these institutional standards or how to comply with them. In the domestic and regional markets consumer's appreciation of quality is taste related, while on the international market, it is more focused on physical attributes and there are stringent quality standard requirements. Exporters face difficulties in complying with these standards. As a result, the majority of Benin's fresh pineapple is sold either on national or regional markets. The low access to financial support leads many farmers to become embedded in different transaction governance structures that allow them to get pre-financing in-cash (for labour payments) or in-kind (fertilizers, pesticides and planting materials) from pineapple traders and exporters, together with some technical assistance such as training and capacity building on farming systems. This form of contract, known as

outgrowing (Brüntrup & Peltzer, 2006; Key & Runsten, 1999; B. Shiferaw, Hellin, & Muricho, 2011; USAID, 2009) helps individual small-scale farmers to access a premium market.

Thereafter, in order to fill the gap in scientific evidence on the determining factors affecting simple or multiple choices of governance structures in agrifood supply chains (Dyer, 1996; Grandori, 1997; Ordóñez Héctor & Palau, 2006; Raynaud, Sauvee, & Valceschini, 2002; Sabidussi, 2009; Zaharieva et al., 2003), the following two research questions were investigated.

3) Faced with a context of different governance structures (GS) and alternative choices, are farmers' selections independent or related?

4) What are the intrinsic (farm and farmers' socioeconomic characteristics) and extrinsic (enabling institutional support, market and transaction attributes) factors that affect the choices about governance structure in the pineapple supply chain?

Theory adopted in this study suggests that, all else being equal, a rational actor will chose a governance structure that performs best in minimising production and transaction costs. This study provides empirical evidence to transaction cost theory and develops Williamson's attributes of transaction by emphasising connectedness as a transaction attribute that is worth considering when analysing the choice of governance structure not only in Benin but also in other developing counties. The connectedness also known as relatedness, or interdependence (Bahli & Rivard, 2002) refers to the interconnections and functional links between tasks or business units (Lowry, Wall, & Selfridge, 2011) and the willingness of chain actors to developing and maintaining relationships and information flows with up-stream and down-stream chain partners (Cheng & Sheu, 2012). Applied to transactions, it is assumed that characteristics of transactions have an impact on connectedness of transactions. E.g. those involving investments which are highly specific and some transactions are largely dependent on others giving rise to hold-up problems and locked-in effects (Slangen *et al.*, 2008). When transactions have a strong connection, a strong coordination mechanism is favourable. The adoption of such mechanisms influences the transaction costs and the type of governance chosen by the actor (Meyer et al., 1992). Our research found that the stronger the ties between the buyer-seller, the higher the transaction connectedness will be preferred, confirming the assertion of Wong and Chan, (1999). As far as food products are concerned because of their perishable attributes, if an upstream chain actor is aware of the quality required and price offered by a downstream actor, this can significantly

influence the upstream actor's preference for a more coordinated type of governance structure (*i.e.* outgrowing or association). Such a result can be used as scientific evidence and guide by policy to reinforce the nation extension system in order to assist smallholder farmers in quality and price knowledge and information sharing (in local languages) and stimulate collective actions through outgrowing schemes and association. In the context of less developed countries characterized by low income and low instruction/education level, this finding can contribute to increasing sellers' awareness of the required quality norms and standards (and offered prices) by buyers of their direct buyers in the chain, and thereafter improve smallholders high income markets access.

A new construct of 'multiple-governance' structure is investigated to increase understanding of how and why farmers select among these governance structures and what guides their decisions. The multi-governance choice has been observed as a strategy of farmers for safeguarding their investments. This strategy is established by farmers to sell the different categories of their product quality to different supply chains. Farmers involved in the outgrowing scheme GS are less likely to be involved in another type of governance; showing the specificity and exclusivity of this type of transaction arrangement in the pineapple supply chain. This study, showing factors underlying the choice of each type of GS, has a potential to be used as a tool for defining intervention strategies for promoting contract enforcement in bi- or multilateral partnerships in agrifood supply chains.

Research questions 5 and 6 are drawn to test whether or not smallholder farmers have been excluded from high income markets, such as EU markets.

5) *Whether or not small-scale farmers are rejected from the growing higher value and emerging regional and urban markets in Sub-Sahara Africa and the EU?*
6) *Which intrinsic and extrinsic factors affect the marketing channel selection?*

The results lead us to reject the widespread assumption that smallholder famers are excluded from international markets, even though the emerging markets are mostly supplied by the medium and large-scale farmers. The results also show that some farmers diversify their production systems by growing two varieties simultaneously. This result is in line with Wilson's

(1986) observation that farmers can use market diversification as a protective measure. Though farmers are mostly not price-makers in fresh pineapple markets, farmers do have some bargaining power when it comes to negotiating for better prices. The empirical results also shed some light on the contemporary issue of marketing channel participation in perishable agrifood chains in West Africa, helping us to disentangle the reasons why farmers (sequentially or simultaneously) choose different marketing channels. It was found that those involved in export marketing channels are less likely to send their pineapples to the urban market. Even though we observed negative correlations between some choices of marketing channel, these correlations are not (statistically) significant. This result is consistent with a market participation study in African countries (Bellemare & Barrett, 2006), which found strong evidence to support the hypothesis that sellers make their market participation and selling volume decisions sequentially rather than simultaneously. Farmers' bargaining power and their physical distance from markets were identified as major determinants of marketing channel selection. Improving the present infrastructure such as roads to access rural area and cooling and handling facilities, may help to overcome this issue. Implementing such long-term investments are beyond individual smallholder farmers' capacity, and therefore request a joint intervention of actors from public and private sectors. For example key actors such as government, NGOs, local community, and technical and financial partners have an important role to play.

Equally, farmers' bargaining power could be improved if they had better access to affordable production and marketing information, concerning techniques for improving quality, new varieties and information on market demand and current market prices. It was also found that the costs of coordinating small-scale producers to ensure that they comply with the stringent requirements of international markets may actually make them less profitable. The study suggests that solutions could be found in focusing on alternative markets such as regional markets and/or less demanding export markets. The study found for farmers to make the optimal decision about where to sell their produce they need information about market requirements in terms of quality, norms, quantity and price. However, smallholder farmers do not have access to such information when they need it. This lack of access to information, coupled with their low education levels, increases their vulnerability to information asymmetries when negotiating with buyers.

Drawing on theories related to the actors' dynamic capabilities and incremental innovations research question 7 examines whether modern information technology can alter smallholder farmers' decision making and overcome information asymmetry issues in pineapple supply chains. Research question 7 reads as follows.

7) How to overcome the market information asymmetry issue in the pineapple supply chain?

Based on lessons learnt from a case study on mobile phone use in Ghana, Beninese pineapple farmers' willingness to use (and pay for) a mobile phone service that provides market and quality information on pineapples was investigated. Request conditions and partnerships among value chain actors to timely access market information were addressed by suggesting a multi-stakeholder platform that may involve public and private sectors to facilitate smallholder actors' access to high income markets (Cavatassi et al., 2011; Mwesige, 2010; Thiele et al., 2011; Thiele et al., 2009). To make this a lasting solution, the platform needs to involve actors from throughout the value chain. Apart from the staff who coordinate and manage the platform (such as Esoko in Ghana), results suggest the need to include representatives of farmers' organizations, the mobile phone operator, national statistics and market information management institutes, research institutes and quality control services.

6.3   Theoretical contributions

The present study introduces the concept of multi-governance in the agri-food chain. Under transaction cost theory economists reasoning, the connectedness of the transactions is a key determinant attribute. Traditional economic theories on how suppliers search for a comparative advantage when selecting the optimal governance structure have significantly contributed to understanding trade at local and international levels (Powell & DiMaggio, 1991; van de Vrande et al., 2009; Williamson, 1985). However they did not explain chain actors multiple choices of governance structures. Focus was on explaining one-to-one governance choice in transactions. The study in Chapter 3 draws on empirical evidence to fill this gap, taking transaction connectedness into account as a key factor for explaining the choice of governance structure. Despite the growing literature on governance structure in food chains (Altenburg, 2006;

Armando, Humphrey, & Fischmann, 2007; De Jong, 1997; Dolan & Humphrey, 2000; P. Gibbon, 2003; Grandori, 1997; Gunsueva, 2010; Liu, 2006; Sauvee, 2002; J. H. Trienekens, 2011), this study contributes to the science by establishing support for a new construct, namely 'multi-governance'. It was demonstrated that actors can simultaneously choose for more than one governance structure in transaction with a main purpose to safeguard investments and reduce risk (Heide & John, 1992; Ritchie & Brindley, 2006). The study helps to identify the reasons guiding the choice of chain governance structure, drawing on a broader range of explanatory factors including intrinsic and extrinsic constructs. The major transaction attributes, which affect the multiple governance choice, are specific investment, transaction connectedness and market stability (price & quantity). This implies that market stabilisation policy will need focus in those key factors. As farmers have self-developed these systems in the context of lack of institutional assistance, any support (from extension services or NGOs) of transaction mechanism could contribute to sustain it over the time. This support can be in forms of promoting contract enforcement in bi - or multilateral partnerships in agrifood chains, finding alternative partnership regarding market demand (attributes) and diversified fruit quality.

The study found that the attributes of transactions should not be considered as one-size-fits-all concepts. One of the transaction attributes that did not apply to the pineapple supply chain is the frequency of the transaction, which was excluded from our models. This is because the production cycle of pineapple is long (14-18 months), implying that a pineapple crop can be harvested only twice in three years. This leads to a low transaction frequency over time.

Adding to the growing literature on market channels selection (Abatekassa & Peterson, 2011; Agarwal & Ramaswami, 1992; Becchetti, Conzo, & Gianfreda, 2011; Boughton et al., 2007; Brewer, 2001; Coughlan et al., 2001; Moreno-Monroy, 2010; Obi et al., 2011; Thiele et al., 2009), Chapter 4 investigates whether smallholder farmers participate in or are rejected from high income market channels. Unlike most of the work dealing with the nature of the producer-distributor relationship (Artle & Berglund, 1959; Coughlan, 1985; van Tilburg & van Schalkwyk, 2012), the study models simultaneous participation in different market channels, with product quality and suppliers' bargaining power being the factors that determine which channels are selected. Williamson (1975, 1979, 1989, 1998) already explained the importance of connectedness of transaction as key determinant attribute in explaining the governance structures. What the

transaction cost theory so far falls short to explain is (1) the generalization of this construct in less developed countries contexts and, (2) the application of this attribute in a context of simultaneous choice of multiple governance structure. The present study therefore contributes to the theory by filling this gap.

6.4 Methodological contributions

The complementary use of probit and multivariate probit models allowed for the validation of the hypothesis that smallholder farmer's decision making processes are inter-related or independent. Use of the probit model showed the determinants of governance choice (chapter 3) and market channel selection (chapter 4), while the multivariate analysis provided further insights into the factors underpinning farmers' choice of multiple governance structures in their transactions and multiple channels for their (differentiated) pineapple products. These two levels of the econometric model provided an empirical basis for describing household-level marketing behaviour, by testing the (in) dependency of choice over marketing channel participation and governance.

6.5 Limitations of the study and suggestions for further research

Despite the interesting findings from our research, there are some limitations that need to be emphasized and reconsidered for further research.

First of all, due to time restrictions the study did not investigate the market prices and cost variations across the different marketing channels. Even though the market selection heavily relies on relative costs and prices, empirical data would have added to the understanding of the marketing selection process. Further research may focus on this limitation and clarify the influence of investment and operational costs (information searching, product collecting and transportation costs, cooling facilities, informal sunk costs, etc.) and market price variations (in local, urban, regional and EU markets) on smallholder farmers' marketing channel selection.

We used a cross-sectional design, thus preventing the investigation of the dynamic effects of downstream information and the collaborative relationship. Further work can consider a longitudinal study to investigate the framework at different points in time.

The limited geographical scope of the study (Atlantique department in Benin), and the used sample size might also prevent the generalisation of our conclusion. Further research may replicate the study in a different setting with different socio-economic structures as well as environmental and ecological contexts.

The in-depth surveys on marketing channel selection and governance structure choices were focused on the production side of the value chain. Analyses were concentrated on some elements of collaboration between farmers and buyers without taking into account other chain segments (traders, processors and exporters). If this kind of study can be carried out in further research, its findings will be very interesting and useful, because that will provide a complete picture of the situation of the whole chain by investigating both upstream and downstream relationships throughout the value chain.

The present study did not investigate the implications and impacts of the marketing channel and governance structure selections on market performance. This would have informed on certain performance indicators such as income, generated added value, trust, and quality, not only at farm level, but also along the chain. Future research can investigate those aspects.

We were able to model the intrinsic and extrinsic patterns (transaction attributes, institutional environment, market attributes, and farm characteristics) that determine the multiple governance choice. The major question that remains unanswered is which kind of a combination of type of governance structures can add up to farmers risk and uncertainty attenuation. Even though farmers explained that they choose multiple governance structures to safeguard risks and reduce uncertainties, the study did not investigate which combination of governance structures could lead to the highest risks and uncertainty attenuation. This limitation can be further investigated in the future research has been added as important limitation and recommendation for further research.

The study has investigated the influence of pineapple quality attributes (Grade A-B-C) on marketing channel selection (chapter 4). We did not assess the impact of multi-governance structures choices and the selected marketing channel on the fruit quality performance especially for processing factories. This limitation came be considered in further research.

Finally, this study is carried out for a limited number of pineapple farmers in Atlantique department in South Benin. This might also prevent the generalisation of our conclusion. Further research could replicate this study in different settings and different agro-ecological zones with a larger sample size.

6.6   Policy and managerial implications

Based on the research findings, several recommendations can be made.

Findings on barriers for smallholder farmers' access to high income markets showed that farmers are facing tremendous constraints to get specific inputs (fertilizers and planting materials) that led them to the development of an outgrowing form of governance structure. Government through his National Research and Extension Services could contribute to overcome this issue by reinforcing interventions on building capacities to develop nurseries and appropriate fertilizer formulas as the one that is being used is adopted from Ivory-Coast without considering the soil fertility and the agro-pedological conditions in Benin.

As found in chapters 2 and 5, there is an important issue related to farmers' access to updated market and quality information to guide them in their decision making processes. The government and supporting partners (such as national and international NGOs) can assist farmers in providing information access on where to get these materials if available, market opportunities and strategies to improved intensive production rather than extensive, as the yield remained stable over the last decade.

Despite the existence of national institutes and support services involved in quality control and in building the capacity of producers to comply with quality standards, it was found that only 2% of national fresh production is exported to EU and Asian markets because of high handling and air freighting costs. To increase the quantity sold to international markets, the government learn from the Ghanaian experience by supporting chain actors in developing cooling chain facilities, which are indispensable for sea freighting. Alternatively, solutions may be found by the government in promoting outgrowing schemes and seizing the opportunity of the available Nigerian markets (consuming more than 40% of pineapple production) after formalizing the trading arrangements (by involving a third party in contracting to safeguard the investments). This arrangement will be helpful in reducing the transaction costs related to informal costs paid by actors because of market information asymmetry along the pineapple supply chain. It will also help to reduce bounded human rationality and opportunistic behaviour as the governance structure will shift from the spot market (most dominant now) to a more integrated one. Also, further research could investigate strategies to change international and regional consumers' orientation towards produce taste instead of physical (colour) appearance. This will help to promote local varieties such as *sugarloaf* – which has a permanent green colour when mature – instead of introducing new varieties or applying the plant growth regulator Ethephon to artificially induce ripeness in the *smooth cayenne* cultivar.

The pineapple supply chain in Benin is recognized as having a huge potential with an highest yield in West-African sub-region (FAOSTAT, 2012), and increasing demand. It is gaining an increased international orientation, despite the low adaptive capacities of smallholder farmers to comply with required norms and quality standards. Although the governance and marketing issues examined in this study are within national and sub-regional boundaries, both buyers and sellers are willing to engage in international markets. Achieving a long-term market access and sustainable chain performance requires establishing a win-win relationship between buyer and seller.

Although the knowledge that farmers have is often underestimated, there exists an asymmetry of information along the supply chain, which unfairly rewards some and excludes others. To overcome this, government can assist smallholder actors in accessing information using their commonly used communication means (mobile telephone) as an appropriate tool to provide a

package of advisory services (current market prices, bids and offers, advice for disease control, quality information, etc). As indicated in Chapter 5, this assistance could be provided through SMS (texting services) preferably in the native language of the farmer. The study has provided a better understanding of the direct impact of ICT in facilitating trading networks, and, most importantly, maintaining product quality by saving on transport and market search time. Moreover, the number of intermediaries involved can be reduced, as can information asymmetry among value chain actors. The establishment of a multi-stakeholder platform, involving actors at different stages of the chain from private and public sectors could make an important contribution to promoting food quality conservation and market access by small-scale actors.

7

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8

APPENDICES

Appendices

Appendix 1: Summary results of principal component analysis

Specificity of investment (Eigenvalues> 2.12; KMO=0.6; Bartlett's Test Chi-Square 210.692***)				
	Mean	Stand. dev.	Factors' Loading	
			Human asset specificity	**Physical asset specificity**
If I stop working with this market, I will lose a lot of knowledge regarding the method of operation in this market	1.28	.887	**0.841**	0.214
Losing investments made in production if switching to another product	1.27	.827	**0.808**	0.011
If my principal client doesn't come on time I lose an important investment	2.10	1.513	**0.752**	-0.227
We made high investments for pineapple production	3.64	1.861	-0.351	**0.755**
We made high investments for upgrading pineapple quality	1.07	.512	0.318	**0.690**
*Uncertainty (*Eigenvalues> 1.5; KMO=0.6; Bartlett's Test Chi-Square 35.641***)				
	Mean	Stand.dev.	**Market Uncertainty**	**Behaviour Uncertainty**
The price we arrange with our most important buyers is stable	3.00	1.409	**0.701**	-0.288
The quality required by our most important buyers is always stable	3.55	1.312	**0.695**	-0.053
The amount of product bought by our most important buyers is always stable	1.45	1.092	**0.691**	0.219
*Connectedness (*Eigenvalues> 1.7; KMO=0.7; Bartlett's Test Chi-Square 67.766***)				
	Mean	Stand.dev.	Factors' Loading **Connectedness**	
We are aware of the required quality by the customers of our direct customers	2.59	1.719	**0.742**	
The harvesting period is determined by the demands of the customers to our direct customers	2.51	1.519	**0.719**	
We receive a command from our buyer before we apply FIT and Ethephon	2.15	1.633	0.629	
We are aware of the price paid by the customers to our direct customers	1.55	1.213	0.522	

Market Attributes (Eigenvalues> 2.9; KMO=0.7; Bartlett's Test Chi-Square 897.609*)**					
	Mean	Stand.dev.	Pre-agreed marketing arrangement	Diversified preference	Permanente demand
Quality is pre-agreed with my buyers	1.74	1.381	**0.884**	-0.048	0.027
Price is pre-agreed with my buyers	1.63	1.386	**0.827**	-0.140	0.011
Specific production and harvesting practices are pre-agreed	1.37	1.086	**0.762**	0.068	0.110
Volume/quantity are pre-agreed with my buyers	1.40	1.114	**0.748**	0.104	0.085
I prefer to sell pineapples to modern markets	3.33	1.724	-0.028	**0.949**	-0.078
I prefer to sell pineapples to different markets	3.34	1.681	-0.061	**0.923**	-0.117
I prefer to sell pineapples using different transaction agreements	3.13	1.725	0.087	**0.830**	-0.126
Existence of permanent pineapple market and demand	4.59	.916	0.036	-0.113	**0.852**
I am able to sell all of my pineapples	4.17	1.355	0.129	-0.135	**0.826**
Institutional support (Eigenvalues>2.3; KMO=0.6; Bartlett's Test Chi-Square 67.766*)**					
			Institutional environment		
The institution assists in providing trainings on good agronomical practices	0.49	0.501	**0.887**		
The institution assists in providing quality norms and standards	0.40	0.492	**0.878**		
The institution assists in search for pineapple buyers	0.12	0.329	**0.626**		
The institution assists in providing/finding inputs	0.15	0.367	**0.591**		
Trust (control) (Eigenvalues> 1.7; KMO=0.7 Bartlett's Test Chi-Square 67.766*)**					
	Mean	Stand.dev.	**Trust and commitment**		
Based on experience, I can rely on the buyers to fulfil agreements with complete confidence	3.39	1.560	**0.923**		
The buyers have been fair in their negotiations with me	3.74	1.287	**0.889**		
My previous relationships with my buyers are satisfactory	3.78	1.239	**0.879**		
I should not hesitate to make important selling decisions based on my buyers' suggestions	3.70	1.387	**0.840**		
I expect the buyers to be working with me for a long time	3.94	1.318	**0.797**		

Appendix 2: Questionnaire for pineapple farmers

Name of Enumerator ……………………………………… **Date ____ /____/_____/** Quest N°/_____/

Identification

Sections	Modalities	Write the answers
First and last name of respondent		
Department		
District		
Village		

a. Personal characteristics

Gender	Age	Education level	Have you received trainings in pineapple production /processing/ trading ?	Who provided the trainings (precise Name)	Pineapple production experience	Type farmer
1=male 0=female	years	0=no education 1=primary school 2=middle school 3=high school 4=university level	1=Yes 0=No	1= extension services, 2=NGOs 3=Research 4=other (précis)	years	1=large (>5ha) 2=medium (1-5ha) 3=small (<1 ha)

1. Have you made any changes in your trade practices in order to improve the quality of products and satisfy your clients during the last five years? □ Yes □ Non
If yes what changes did you make?
a_____
b_____
c_____

If no why don't you change?
a_____
b_____
c_____

Resources

1. How much farmland do you own? _____ (*ha*)
2. How much farmland do you use for pineapple production? _____(*ha*) or _____ (%)
3. How many pineapples do you harvest during the last season? _____ (kg)
4. Which variety of pineapples do you produce and what are the proportions of each of them?
   - ❑ Cayenne smooth (Abacaxi) _____%
   - ❑ Pain de sucre (sugarloaf) _____%
   - ❑ Others (specify) ( )_____%
   100%

b. Channel choice

> Please select the two most important pineapple markets for you _____ and _____ then answer the following questions:
> 1=*local market; 2=urban market; 3= processing company; 4= exporting company;5= Regional market, 6=Other (to be specified)*
> (_____)
> *If you only have one market, then the following questions are answered according to this market, no answer for 2nd market.*

Please indicate your response to the following statements.

	1st market	2nd market
5. How far is this market away from your home?_____ (km)		_____
6. How long does it take to reach this market?_____ (hours)		_____
7. What transportation vehicle do you use for this market (specify) _____		_____

8. Would you please select your pineapple destination and write the development for each of them in terms of sales percentage for the last two pineapple seasons and expected in 2011 respectively?

	Last period	2periods ago	expected in 2011 (next period)	Experience
Local market _____(years)	_____%	_____%	_____%	
Urban market _____(years)	_____%	_____%	_____%	
Processing company _____(years)	_____%	_____%	_____%	
Exporting company/assoc. _____(years)	_____%	_____%	_____%	
Regional market _____(years)	_____%	_____%	_____%	
Other (specify) ( ) _____(years)	_____%	_____%	_____%	
Total	**100%**	**100%**	**100%**	

For the selected channel(s), please indicate what the characteristics of each of them are:

	not true at all 1st market totally true	2nd market
9. This market requires consistent quality pineapples	1 2 3 4 5	_____
10. This market has accurate delivery time and delivery place	1 2 3 4 5	_____

Please indicate your response to the following statements:

	not true at all totally true
11. I am able to sell all of my pineapples	1 2 3 4 5
12. I prefer to sell pineapples to different markets	1 2 3 4 5
13. I prefer to sell pineapples to modern markets, such as supermarkets, processing companies, exporting companies, etc.	1 2 3 4 5
14. I prefer to sell pineapples using different transaction agreements	1 2 3 4 5

Are there any other reasons for your choice of buyer?

_____

_____

c. Transaction attributes
The transaction attributes are related to a set of constructs defined by Williamson explaining what the determinants of the transaction cost are. The transactions are described by the following three TAs: specificity of the investments; uncertainty regarding the process and the value of the transaction; connectedness. These attributes of the transaction are assumed to affect the choice of a channel and also the choice of the GS.

Transaction specific investments
The specificity of the investment is reflected by the non-transferability of this investment to other activities or to other segments of the chain. An investment is considered to be specific for an asset when its procurement requires a large amount of money (> 50,000 fcfa). Human, site and the temporal specificity are considered in this study.

Please indicate your response regarding the following statements.

	not true at all	1st market	totally true	2nd market
15. We have made large investments (> 50,000 FCFA) for pineapple production in the last 5 years	1	2 3 4	5	_____
16. We have made a large investment (> 50,000 FCFA) for upgrading pineapple quality in the last 5 years	1	2 3 4	5	_____
17. We have made a large investment (> 50,000 FCFA) for acquiring knowledge and training in pineapple trading during the last 5 years	1	2 3 4	5	_____
18. We have made significant investments to deliver products to this market	1	2 3 4	5	_____
19. If we switch to another market we would lose a lot of investments that we have made to sell to this market	1	2 3 4	5	_____
20. If we decided to stop working with this market, we would lose a lot of knowledge regarding the method of operation in this market	1	2 3 4	5	_____

Transaction uncertainty
The transaction uncertain is seeing from two angles: the uncertainty of the transaction and human opportunism behaviour. This component of TAs are determinant to explain the high or low level of the transaction cost.

	not true at all	1st market	totally true	2nd market
21. The amount of product bought by our most important buyers is always stable	1	2 3 4	5	_____
22. The quality required by our most important buyers is always stable	1	2 3 4	5	_____
23. The price we arrange with our most important buyers is stable	1	2 3 4	5	_____
24. The amount of product is never affected by the unpredictable climate change (instability of the rainfall between years)	1	2 3 4	5	_____

Connectedness to other transactions

	not true at all	1st market	totally true	2nd market
25. I am aware of the required quality by the customers of my direct customers	1	2 3 4	5	_____
26. I am aware of the price paid by the customers to my direct customers	1	2 3 4	5	_____
27. The harvesting period is determined by the demands of the customers to my direct customers	1	2 3 4	5	_____
28. I receive supports from buyer (or other chain actor) to harvest to products	1	2 3 4	5	_____

Access to information

The channel used to get information on the market and the required quality in different markets is also an aspect that determines the choice of a particular market or GS. It is considered to be a transaction attribute that can permit to get further insight into the choice made by each actor involved in a segment of the chain. For this purpose the following questions are posed:

29. In which way do you get the information? □verbally, □ written, □ mobile (or SMS)
30. Do you use intermediaries to get access to information on the availability of buyers? □ yes, □ no
31. How much time do you spend getting the price information? _____(hour)
32. How important is the following information to your activities and where do you get it?

Information type	Importance	Main source
Product price	1 2 3 4 5	_____
Selling location (distance)	1 2 3 4 5	_____
Quality of inputs	1 2 3 4 5	_____
Quantity of inputs	1 2 3 4 5	_____
Quality asked in the market	1 2 3 4 5	_____
Supply chain actor´s reputation	1 2 3 4 5	_____

d. Governance structure

Based on Williamson's perception of TCE, GS is considered to be a form of relationship arranged by the actor with their upstream suppliers. This relationship can be a spot market type (without any arrangement) with contract arrangement (formal or informal). The following questions will help to understand what these arrangements are.

33. Please, indicates what type of arrangement is commonly used by you in selling your product, and select the duration of this arrangement:
    Verbal arrangement □one harvest □ one season □several seasons □ Other (specify)(_____)
    Written arrangement □one harvest □ one season □several seasons □ Other (specify)(_____)

34. Please, indicates what type of arrangement is commonly used to get your inputs (e.g. Ethephon or fertilizers) and select the duration of this arrangement:
    - Verbal arrangement □one harvest □ one season □several seasons □ Other (specify)(_____)
    - Written arrangement □one harvest □ one season □several seasons □ Other (specify)(_____)

Please, can you specify what terms are indicated in the agreement:

	not true at all	1st market	totally true	2nd market
35. My transactions with buyers are based on written contracts		1 2 3 4 5		_____
36. Price is pre-agreed with my buyers		1 2 3 4 5		_____
37. Quality is pre-agreed with my buyers		1 2 3 4 5		_____
38. Specific production and harvesting practices are pre-agreed		1 2 3 4 5		_____
39. Volumes are pre-agreed with my buyers		1 2 3 4 5		_____
40. Delivery time and place are pre-agreed with my buyers		1 2 3 4 5		_____
41. Buyer pre-pays (credit) for my farm activities		1 2 3 4 5		_____
42. Buyer directly provides me some input (e.g. Ethephon or fertilizer)		1 2 3 4 5		_____
43. Buyer follows the quality of pineapple on farm and sometimes provides me with trainings, monitoring and or technical assistance		1 2 3 4 5		_____
44. Clauses that define penalties if deadlines, services or products are not met, or product quality is not fulfilled		1 2 3 4 5		_____
45. I belong to a producers' cooperative which follows the quality of pineapple on farm		1 2 3 4 5		_____
46. I belong to a producers' cooperative which provides with trainings and monitoring assistance		1 2 3 4 5		_____

Please, can you specify what terms are indicated in the agreement:

	not true at all 1st market	totally true	2nd market
47. I belong to a producers 'cooperative which takes all my product and helps to find market	1 2 3 4 5		_____

Trust

	not true at all 1st market	totally true	2nd market
48. The buyers I trade with have a good reputation	1 2 3 4 5		_____
49. I should not hesitate to make important selling decisions based on my buyers' suggestions	1 2 3 4 5		_____
50. My previous relationships with my buyers are satisfactory	1 2 3 4 5		_____
51. I expect the buyers to be working with me for a long time	1 2 3 4 5		_____
52. The buyers have been fair in their negotiations with us	1 2 3 4 5		_____
53. The buyers may act at our expense	1 2 3 4 5		_____
54. Based on experience, I can rely on the buyers to fulfil agreements with complete confidence	1 2 3 4 5		_____

e. Performance

Sales growth

All the information collected above will be considered as explanatory variables to understand the performance of this segment of the chain.
Will be considered as performance indicators: sales growth, the quality performance and the profit margin

55. Considering the year 2008 as equal to 100%, what has been the development of your pineapple sales?

	Cayenne smooth cultivar		*Pain de sucre cultivar*	
	1st market	2nd market	1st market	2nd market
2005	_____%	_____%	_____%	_____%
2009	100%	100%	100%	100%
expected in year 2011	_____%	_____%	_____%	_____%

56. What do you think that are the main causes of these developments?

1st _____

2nd _____

3rd _____

	not true at all	1st market	totally true	2nd market
57. My buyers are satisfied with the quality of my pineapples		1 2 3 4 5		_____
58. I am happy with the price I get from my buyers		1 2 3 4 5		_____
59. I get a good price for high quality pineapples from my buyers		1 2 3 4 5		_____

Quality perception and pineapple rejection

60. What are are the vous quand dit-on qu'un ananas est de bonne qualité ?

a _____

b _____

c _____

61. Are you used to apply Ethephon/Ethrel for uniform maturity of the pineapple? ☐Yes   ☐No

62. If yes at which moment of the production cycle you apply it? _____(months after planting)

63. Sort the elements of quality below from the most important to the least important

Activities	*Smooth cayenne cultivar*				*Sugarloaf cultivar*			
	Low importance	*1st market*	high importance	*2nd market*	Low importance	*1st market*	high importance	*2nd market*
Control of maturity days	1 2	3	4 5	_____	1 2	3	4 5	_____
Peal colour	1 2	3	4 5	_____	1 2	3	4 5	_____
Pulp colour	1 2	3	4 5	_____	1 2	3	4 5	_____
Fruit size	1 2	3	4 5	_____	1 2	3	4 5	_____
Fruit shape	1 2	3	4 5	_____	1 2	3	4 5	_____
No external damage	1 2	3	4 5	_____	1 2	3	4 5	_____
No internal damage	1 2	3	4 5	_____	1 2	3	4 5	_____
Fruit taste	1 2	3	4 5	_____	1 2	3	4 5	_____
Fruit firmness	1 2	3	4 5	_____	1 2	3	4 5	_____

64. Did you experience cases of rejection of your product? Yes ☐   No ☐   If no continue wit question 81

Rejection	Percentage	What are the main cause	What is done with the rejected pineapple
In farm for the export market	_____%		
In the harbour for export market	_____%		
In the farm for urban market	_____%		
In the urban market	_____%		
In the farm for local market	_____%		
In the local market	_____%		
In the farm for the processing company	_____%		
Other (_____)	_____%		

65. Can you please indicate the proportion of the pineapple you sold for the following quality grade in the last season:

Pineapple grade	Grade description	Smooth cayenne				Sugarloaf			
		Percentage of trade product (%)	Price			Percentage of trade product (%)			
			Local market	Regional market	EU market		Local market	Regional market	EU market
Grade III (class C)	- **very small** *weight* **significantly** *lower than (700g)* - **defects in shape & presence of fungus**								
Grade II (class B)	- **medium size** *and Weight (slight < 700g or slightly > 700g)* - **slight defects in shape almost absence of fungus**								
Grade I (class A)	- **No physical damage and absence of fungus** -*Weight ≈700g* (**big**)								

Profit margin

66. Would you please select the range of your total sales and profit for your pineapple sale in 2009?

SALES
- ❑ Lower than 100,000 *FCFA*
- ❑ Between 100,000 and 500,000 *FCFA*
- ❑ Between 500,000 and 1,000,000 *FCFA*
- ❑ Between 1,000,000 and 5,000,000 *FCFA*
- ❑ Higher than 5,000,000 *FCFA*

PROFIT
- ❑ Negative profit (lost)
- ❑ Positive but lower than 100,000 *FCFA*
- ❑ Between 100,000 and 500,000 *FCFA*
- ❑ Between 500,000 and 1,000,000 *FCFA*
- ❑ Between 1,000,000 and 5,000,000 *FCFA*
- ❑ Higher than 5.000.000 *FCFA*

f. *Institutional environment and arrangement*

We want to get an idea about the benefits/assistance you get from institutional environment for your pineapple production and marketing. Please indicate your response to the following statements.

What are the existing institutions/organisations (extension services, NGOs, Research, Banks and credits facility-formal & informal- institutions) that support pineapple production in your village? Select the two main.

	1st institution	2nd institution
Name of the institutions	_____	_____

	Low importance	1st inst	high importance	2nd institution
Degree of relevance of assistance	1 2	3	4 5	_____
Frequency of their visit	1 2	3	4 5	_____
Level of practicability/applicability of the intervention	1 2	3	4 5	_____

Which role do these institutions play - according to you:

	not true at all	1st institution	totally true	2nd institution
67. to find new buyers and new markets		1 2 3 4 5		_____
68. to inform us about the required quality standards and norms		1 2 3 4 5		_____
69. to get payment more quickly		1 2 3 4 5		_____
70. to improve my production technology		1 2 3 4 5		_____
71. to order through telephone		1 2 3 4 5		_____
72. to get credits from my buyers quickly		1 2 3 4 5		_____
73. to get planting material or other inputs		1 2 3 4 5		_____
74. to provide credit/loan for pineapple production (or help to get credit from banks)		1 2 3 4 5		_____
75. Other role (…………………………….)		1 2 3 4 5		_____

76. Are the required conditions easy to fulfil to get these services? □Yes □No
77. What makes it easier or difficult? Give one reason for each institution

1st_____

2nd_____

3rd

Inst_____

Are you charged for these services? □Yes □No

g. Using ICTs to receive market and quality information in pineapple supply chain

The goal here is to assess perceptions of the traders on the application of innovation using new communication technology and new institutional arrangement for quality and price information diffusion among chain actor.

Please to give a grade/score to   the following innovation according to your perceptions and their own conditions?

Do you have a mobile phone?   □Yes   □No
Do you use mobile phone ?□Yes   □No
What is telephone number? /_____/

	not true at all totally true	How much are you will to pay for this (≤4000 FCFA)	What are the requested condition
1. I acknowledge that the use of SMS from mobile can help to improve my access to the information on quality request by the customers	1 2 3 4 5		
2. I am willing to get quality information (Norms and disease control) via SMS	1 2 3 4 5		
3. I acknowledge that the use of SMS from mobile can be help to improve my access to the information on market price of pineapple	1 2 3 4 5		
4. I am willing to pay to get price information via SMS	1 2 3 4 5		
5. I acknowledge that the use of SMS from mobile can help to make offers of my product to buyers	1 2 3 4 5		
6. I am willing to pay to make product offers via SMS	1 2 3 4 5		

9

SUMMARIES IN ENGLISH AND DUTCH

Summary

This study, part of CoQA's multidisciplinary research, programme, aims to identify and characterize the marketing channels that smallholder farmers participate in, their governance structures (GSs) and explore an innovative mechanism to overcome market information asymmetric in Benin's pineapple supply chain.

Primary producers in low income countries face a range of obstacles: poor infrastructure, the lack of an enabling environment that offers institutional support, and of available resources and inefficiently and ineffectively coordinated value chains. Smallholder producers are at a particular disadvantage because they have little capital endowment to invest, rely on traditional techniques and family labour and lack contact with (international) market players. There is much literature on participation in market channels, with most of the work dealing with the nature of the producer-distributor relationship. However these studies have not modelled simultaneous participation in different market channels and did not seek to determine the role of product quality and suppliers' bargaining power as factors. Smallholder farmers also lack vertical linkages and collective actions in marketing channels which, some argue, results in their exclusion from international (export) markets. It has also been argued that the bargaining power of chain stakeholders in marketing channels plays major role in excluding smallholder farmers from markets.

However, most of this evidence comes from the South African context, and needs to be validated in different agro-ecological and economic contexts. This thesis examines the pineapple supply chain in Benin where most production is in the Guineo Congolian agroecological zone, and is largely oriented towards national and regional markets, which have less stringent quality and standards requirements than European markets. This thesis explores the extent to which the factors discussed above hold true in the Beninese context, and seeks to add to the literature that seeks to explain why small scale producers in Sub-Saharan African (SSA) countries often do not benefit from the growth of higher value commodity chains in emerging regional and urban markets.

Mapping and chain barriers

Chapter 2 maps Benin's pineapple supply chains, paying particular emphasis to the forms of relationships between chain actors, the constraints and challenges they face and strategies they

adopt for improving quality and market access. This sheds light on the GSs already established and the extent to which these fill the existing gap of limited institutional support and reduce transaction costs. An overview of the pineapple supply chain in Benin is provided, indentifying the principal chain actors, their roles, importance, targeted markets and positions along the supply chain. Using a case study approach, it identifies the main issues about quality and market access along the supply chain, the socio-cultural conditions that affect profitability and the strategies developed to cope with the recurrent barriers. It was found that these barriers include (1) a lack of appropriate financial support (low market access and high interest rates) for a crop that is highly financially demanding (needing an average initial investment of $US 4,500 per hectare). (2) High quality standards on international markets, which act as barriers for small-scale producers: as a result of these Benin has only two companies exporting fresh pineapple to the EU. The majority of fresh pineapple is sold either on national or regional markets. The few farmers who do participate in international markets are engaged in outgrowing schemes, a hierarchical governance structure that allows them to reach these markets. (3) There is a lack of adequate transport facilities, resulting in the frequent overloading of fruit in trucks and cars and leading to high levels of damage (about 20%) to the fruit. (4) The chain is also characterized by high transaction costs, and weak levels of trust among chain actors, which give rise to conflicts between buyers and sellers. (5) Finally, farmers located in rural areas, have poor access to quality and market information both for inputs and products. One way of reducing transaction costs, may be to promote outgrowing schemes and develop formalized trading arrangements (involving a third party to safeguard investments) focused on the existing Nigerian market.

Governance structures

Chapter 3 provides empirical evidence on the determinants of producers' choice of governance structures. It is based on transaction cost theory and considers the connectedness of a transaction as a determinant of producers' choice of GS. It employs a multivariate econometric approach to explain why smallholder farmers generally opt for multiple governance strategies in their transactions. The study develops Williamson's concept of the attributes of transactions by emphasizing connectedness as an important attribute when making a choice about governance structure in less developed counties like Benin. The construct of multiple-governance structure was investigated to further understand how and why farmers select among these governance structures and what guides their decisions. Farmers opt for multi-governance as a strategy to

safeguard their investments. This strategy is used by small-scale farmers as a means of selling different categories (in terms of quality) of their produce to different supply chains. Farmers involved in the outgrowing scheme GS are less likely to be involved in another type of governance; showing the specificity and exclusivity of this type of transaction arrangement in the pineapple supply chain.

Marketing channel participation

Chapter 4 investigates the determinants of smallholder farmers' marketing channel participation decisions. It does so by complementarily using simple and multivariate Probit models. It provides insights into the influence of farmers' characteristics (age and education level), their production systems (farm size and produced varieties), product quality (quality requirement and rejection rates) and marketing context (distance, the formality of the buyer-seller relation, the duration of the relationship, written contract) on participation in four major marketing channels (rural, urban, fresh export, and processing markets). The assumption that smallholder famers are excluded from international markets is rejected. Farmers diversify their production systems by planting two varieties simultaneously as a protective measure to safeguard their investments. Those involved in export marketing channels are less likely to send their pineapples to the urban market. The chapter contributes to theory by identifying that farmers supply the market channel best suited to the attributes of their produce. Bargaining power and physical distance were also identified as major determinants of marketing channel selection. Improving the existing physical infrastructure could help to overcome this problem. Alternatively, a solution could be found in enhancing farmers' bargaining power through improving their access to information about production and markets (quality improvement techniques, market demand, up-to-date market prices and new varieties).

Dealing with information asymmetry

Chapter five assesses farmers' willingness to use a mobile phone to supply and receive market and quality information on pineapple, and the amount they would be willing to pay for these services, which would overcome information asymmetry issues in the along the value chains. Request conditions and partnerships among value chain actors for sustainable smallholders' access to high income markets were addressed by suggesting an ICT based multi-stakeholder platform for market information access. The chapter illustrates the potential value of ICT in

facilitating trading networks, and, most importantly, maintaining product quality, saving transport and market search time and reducing the number of unnecessary intermediaries. Lessons learnt from the case study in Ghana show the potential importance of ICT in developing and promoting quality and market access in fresh agri-food supply chains, not only in Benin but also across SSA countries that face similar challenges.

Managerial implications

Despite the existence of national institutes and support services involved in quality control and strengthening actors' capacity to comply with quality standards, there is a clear need to design a better mechanism for coordinating the supply chain. If small scale producers are to respond to the quality norms and standards for regional and international markets they need to make investments in their production. Such investments ether from state, financial partners or NGOs are needed for building roads, cooling chain, safe handling and storage facilities, waste chemical disposal pits, hand washing facilities, personal protective equipment, knapsack sprayers, certified planting material, etc. The study suggests that promoting outgrowing schemes (aimed at the existing Nigerian markets) may be the best way to do this. Such arrangements would help to reduce the transaction costs related to market information asymmetry along the pineapple supply chain and the informal costs this gives rise to. It would also help to reduce bounded human rationality and opportunistic behaviour and would shift the governance structure from the spot market (now dominant) to a more integrated one. Pineapple production in Benin is recognized as having a huge potential. The supply chain is acquiring an increased international orientation despite the low adaptive capacities of smallholder farmers to comply with required norms and quality standards. Although the knowledge that farmers have is often underestimated, the supply chain is characterized by an asymmetry of information which unfairly rewards some and excludes others. To overcome this situation, information and communication technologies (ICT), such as a mobile phone IMS platform, could be an appropriate tool to provide smallholder farmers with a package of advisory services about current market prices, bids and offers, advice for disease control, quality information, etc. These services could be provided at a low cost, through an SMS service in a local language understandable to the farmer. Even though farmers showed a high WTP for a mobile phone-based MIS, it remains important to assess how the existing infrastructure and institutional organizations can support such a process and make it effective. This offers opportunities for future development and policy-oriented research.

Samenvatting

Deze studie, onderdeel van het multidisciplinaire onderzoeksprogramma CoQA's, is gericht op het identificeren en het karakteriseren van marketing kanalen waaraan kleine boeren deelnemen, de daarin gehanteerde governance-structuren (GS) en het verkennen van innovatieve mechanismen om een asymmetrische verdeling van marktinformatie over betrokken actoren in de Beninese ananas keten te overwinnen.

Primaire producenten in landen met lage inkomens worden geconfronteerd met een aantal barrières: slechte infrastructuur, het gebrek aan institutionele ondersteuning, onvoldoende middelen, en inefficiënt en ondoelmatig gecoördineerde waarde-ketens. Kleinschalige producenten zijn in het nadeel, vanwege hun lage vermogenspositie om te investeren, hun vertrouwen op traditionele technieken en op gezinsarbeid, en een gebrek aan contact met (internationale) marktpartijen. Er is veel literatuur over participatie in marketing kanalen, waarin de meeste aandacht uitgaat naar de aard van de relatie tussen producent-distributeur. Deze studies nemen niet de mogelijke, gelijktijdige deelname van ketenpartijen aan verschillende marketing kanalen in beschouwing. Tevens nemen deze studies de kwaliteit van het product en de onderhandelingspositie van leveranciers niet mee als factoren. Kleine boeren ontberen ook verticale relaties en collectieve acties in marketing kanalen. Dit verklaart, volgens sommigen, de uitsluiting van kleine boeren van internationale (export) markten. In de literatuur wordt tevens verondersteld dat de onderhandelingspositie van ketenpartijen in marketing kanalen een belangrijke rol speelt in het uitsluiten van kleine boeren van markten.

Echter, het grootste deel van de genoemde studies is uitgevoerd in Zuid-Afrikaanse context, en dient nog te worden gevalideerd in andere agro-ecologische en economische contexten. Dit proefschrift onderzoekt de ananas keten in Benin waar de meeste productie plaats vindt in de Guineo Congolian agro-ecologische zone. De studie is grotendeels gericht op de nationale en regionale markten, die minder strenge kwaliteitseisen en normen stellen dan de Europese markten. Dit proefschrift onderzoekt de mate waarin de hiervoor besproken factoren van invloed zijn op de Beninese ananas keten. Tevens wordt gepoogd een bijdrage te leveren aan de literatuur op het terrein van verklaringen waarom kleinschalige producenten in SSA vaak niet profiteren van de groei van basisproduct-ketens die een hogere waarde genereren, in opkomende regionale en stedelijke markten in SSA.

In kaart brengen van de keten en van barrières in de keten

In hoofdstuk 2 is de Beninese ananas keten in kaart gebracht met daarbij bijzondere aandacht voor de relaties tussen actoren in de keten, en de beperkingen van en uitdagingen waarmee deze ketenactoren worden geconfronteerd en de strategieën die zij vaststellen om de kwaliteit van de ananas en toegang tot de markt te verbeteren. Deze inzichten kunnen mogelijk de reeds aanwezige GS's verduidelijken en met name de mate waarin deze als een aanvulling kunnen functioneren op de beperkte institutionele steun en mogelijk kunnen helpen om de transactiekosten in de keten te verlagen. De ananas keten in Benin wordt gepresenteerd waarin de belangrijkste keten actoren zijn geïdentificeerd, en hun rol, belang, markten en posities binnen de keten zijn toegelicht. Met behulp van een case studie benadering, komen de belangrijkste kwesties ten aanzien van kwaliteit en de toegang tot de markt, de sociaal-culturele omstandigheden die van invloed zijn op de winstgevendheid en de reeds ontwikkelde strategieën met betrekking tot de steeds terugkerende barrières, aan de orde. De volgende barrières komen aan de orde. (1) Een gebrek bij kleine boeren aan voldoende financiële draagkracht (lage markttoegang en hoge rente) voor het verbouwen van een financieel veeleisend gewas (een gemiddelde initiële investering van $ US 4500 per hectare). (2) Hoge kwaliteitsnormen op de internationale markten, die fungeren als barrières voor kleine boeren. Als gevolg hiervan heeft Benin slechts twee bedrijven die verse ananas naar de EU exporteren. Het grootste deel van de verse ananas wordt verkocht op de nationale of regionale markten. De weinige boeren die deelnemen aan internationale markten houden zich bezig met zogenoemde 'outgrowing schemes', een hiërarchische GS die hen in staat stelt deze markten te bereiken. (3) Er is een gebrek aan adequaat vervoer. Dit resulteert in veelvuldige overbelasting van fruit in vrachtwagens en auto's, met als gevolg een hoge mate van schade (ongeveer 20%) aan de vrucht. (4) De keten wordt ook gekenmerkt door hoge transactiekosten, en een laag vertrouwen tussen actoren, dat aanleiding geeft tot conflicten tussen kopers en verkopers. (5) Tot slot, de boeren in plattelandsgebieden, hebben weinig toegang tot kwaliteit- en marktinformatie voor zowel grondstoffen als voor eindproducten. Een manier om transactiekosten te reduceren, kan zijn om 'outgrowing schemes' te bevorderen en de ontwikkeling van geformaliseerd handelsverkeer te stimuleren (betrokkenheid van een derde partij om investeringen te beschermen) dat gericht is op de bestaande Nigeriaanse markt.

Governance-structuren

In hoofdstuk 3 is empirisch bewijs gepresenteerd voor de factoren die van invloed zijn op de keuze van GS's. De bevindingen zijn ingegeven door een theoretisch kader met als kern de transactiekosten theorie en waarin 'verbondenheid van transacties' als belangrijke factor voor keuze van GS is opgenomen. In de analyse is gebruik gemaakt van een multivariate econometrische benadering om te kunnen ingaan op het gelijktijdig gebruiken van GS's door kleine boeren in hun transacties. Deze studie ontwikkelt Williamson's concept van de attributen van de transacties verder door verbondenheid van transacties te benadrukken als een belangrijke factor bij het kiezen voor een GS in minder ontwikkelde landen als Benin. Het construct van multi-GS is onderzocht om beter te begrijpen hoe en waarom kleine boeren kiezen voor deze GS's en wat voor hen leidend is in deze beslissingen. Boeren kiezen voor multi-GS als een strategie om hun investeringen te beschermen. Deze strategie wordt door kleine boeren gebruikt als een middel om de verschillende categorieën (in termen van kwaliteit) van de door hun geproduceerde producten in verschillende ketens te kunnen verkopen. Boeren die betrokken zijn bij de GS 'outgrowing scheme', hebben minder kans om betrokken te zijn in een ander type GS. Deze bevinding geeft aan dat de 'outgrowing scheme' een specifieke en exclusieve vorm van GS is in de ananas keten van Benin.

Participatie in marketing kanaal

In hoofdstuk 4 zijn de factoren gepresenteerd die van invloed zijn op beslissingen van kleine boeren voor participatie in bepaalde marketing kanaal. De analyse is uitgevoerd door op een complementaire wijze eenvoudige en multivariate Probit modellen te gebruiken. Het geeft inzicht in de invloed van kenmerken van boeren (leeftijd en opleidingsniveau), hun productiesystemen (omvang van de bedrijven en geproduceerde variëteiten), kwaliteit van het product (kwaliteitseis en afkeuringspercentage) en marketing omgeving (afstand, de formaliteit van de koper-verkoper relatie, de duur van de relatie, de schriftelijke overeenkomst), op de deelname aan vier belangrijke marketing kanalen (landelijk, stedelijk, export van verse producten en de markt voor verwerking van de ananas). De veronderstelling dat kleine boeren zijn uitgesloten van internationale markten, wordt afgewezen. Boeren diversifiëren hun productiesystemen door het planten van twee rassen tegelijk als een maatregel om hun investeringen te beschermen. Degenen die betrokken zijn bij export marketing kanalen zijn minder geneigd om hun ananas op de stedelijke markt aan te bieden. In dit hoofdstuk wordt bijgedragen aan theorie door aan te tonen dat boeren hun

producten leveren aan dat marketing kanaal dat het beste past bij de kenmerken van hun product. De factoren onderhandelingspositie en fysieke afstand zijn ook vastgesteld als zijnde belangrijke factoren die van invloed zijn op de keuze voor een marketing kanaal. Verbetering van de bestaande fysieke infrastructuur kan helpen om de factor fysieke afstand minder beperkend te maken. Daarnaast kan met betrekking tot verbetering van 'onderhandelingspositie' een oplossing worden gevonden in het vergroten van de toegang van kleine boeren tot informatie over productie en markten (kwaliteitsverbetering technieken, de marktvraag, up-to-date marktprijzen en nieuwe rassen).

Omgaan met informatie-asymmetrie

In hoofdstuk vijf wordt ingegaan op de bereidheid van boeren om een mobiele telefoon te gebruiken om markt- en kwaliteitsinformatie over ananas aan te leveren en te ontvangen. Tevens komt daarbij het bedrag aan de orde dat zij bereid zouden zijn te betalen voor deze diensten en daarmee informatie-asymmetrie in de waarde keten te reduceren dan wel te overwinnen. Door een ICT gebaseerd multi-stakeholder platform voor uitwisseling van de genoemde informatie te suggereren, is ingegaan op voorwaarden en partnerschappen tussen de waardeketen-actoren, om voor kleine boeren duurzaam toegang te creëren tot markten waarin hogere inkomens haalbaar gaan worden. In dit hoofdstuk is de potentiële waarde van ICT geïllustreerd voor het faciliteren van de handel binnen netwerken, en, belangrijker nog, het handhaven van de kwaliteit van het product, het reduceren van transport en van tijd om marktpartijen te zoeken, en het verminderen van het aantal onnodige tussenpersonen. De case studie in Ghana toont het potentiële belang aan van ICT in het ontwikkelen en bevorderen van kwaliteit en van toegang van agro-food vers-ketens tot de markt, niet alleen in Benin, maar ook in SSA landen die soortgelijke uitdagingen kennen.

Management implicaties

Ondanks het bestaan van nationale instituten en ondersteunende diensten gericht op kwaliteitscontrole en het in staat stellen van ketenactoren om aan kwaliteitsnormen te voldoen, is er een duidelijke behoefte aan een beter coördinatie-mechanisme in de keten. Als kleine boeren in staat moeten zijn om te voldoen aan kwaliteitseisen en normen gesteld door regionale en internationale markten, dan zijn investeringen in productie en ondersteuning van ketenactiviteiten nodig. Dergelijke investeringen, gedaan door overheid, financiële partners of ngo's, zijn nodig

voor het aanleggen van wegen, koeling door de keten heen, veilige faciliteiten voor verwerking en opslag, chemische afvalverwerking, faciliteiten voor het wassen van handen, persoonlijke beschermingsmiddelen, op de rug gedragen spuiten, gecertificeerd plantmateriaal, enz.. De onderhavige studie suggereert dat het stimuleren van 'outgrowing schemes' (gericht op de bestaande Nigeriaanse markten) een goede manier kan zijn om dit te bereiken. Een dergelijke GS kan bijdragen aan het reduceren van transactiekosten voor het verkrijgen van marktinformatie en daarmee het verminderen van de informatie-asymmetrie in de ananas keten. Het zou ook helpen om de huidige begrenzing van menselijke rationaliteit van beslissers in de keten en van opportunistisch gedrag, te verminderen. De GS zou dan vervolgens verschuiven van spotmarkt georiënteerde GS (nu dominant) naar een meer geïntegreerde GS. Het enorme potentieel van de ananas productie in Benin wordt erkend. De ananas keten is bezig een steeds grotere internationale oriëntatie te verwerven, ondanks het lage aanpassingsvermogen van kleine boeren aan vereiste normen en kwaliteitseisen. Hoewel de kennis die boeren hebben vaak wordt onderschat, wordt de keten gekenmerkt door informatie-asymmetrie. Deze informatie-asymmetrie zorgt er voor, dat sommigen in de keten worden beloond en anderen worden uitgesloten. Een manier om deze situatie te overwinnen is het introduceren van informatie- en communicatietechnologie (ICT), zoals een mobiele telefoon IMS-platform, om kleine boeren te voorzien van informatie over huidige marktprijzen, biedingen en aanbiedingen, adviezen voor ziektebestrijding, kwaliteitsinformatie, enz. Deze diensten kunnen worden geleverd tegen lage kosten, en door middel van een sms-dienst in een lokale taal die begrijpelijk is voor boeren. Hoewel de boeren een hoge bereidheid toonden voor een mobiele telefoon op basis van MIS, blijft het belangrijk om te beoordelen hoe de bestaande infrastructuur en institutionele organisaties een dergelijk proces kunnen ondersteunen en doeltreffend maken. Dit biedt kansen voor toekomstige ontwikkeling en voor beleidsgericht onderzoek.

About the Author

Djalalou-Dine Adémonla Alamou Arinloye was born in Sakété, Benin on 24 August, 1980. He obtained the degree of Agronomist in 2005 from the Faculty of Agricultural Sciences of the University of Abomey-Calavi (Benin). From 2005 to 2006, and based on his interest in agricultural economics, he obtained the Engineer Agronomist degree with the specialization of Rural Economics. From 2006 to 2007, he was working as Research Assistant at the Agricultural Policy Analysis Unit of the National Agricultural Research Institute of Benin (PAPA/INRAB). He was admitted at the International Institute of Tropical Agriculture (IITA) – Benin as Agricultural Economist from 2007 to 2008, with main occupation in social economics studies, training courses on value chain analysis, market studies and multi-stakeholders innovation platforms assessment. On October 2008, he started his PhD research in multidisciplinary groups including Management Studies/Business Administration group (Social Sciences) and Quality and Food Design group (Food Technology) at Wageningen University. His current research focuses on value chain analysis, information and communication technologies in agricultural sector and multi-stakeholders innovation platforms for technologies adoption and markets access.

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Completed Training and Supervision Plan

Name of the activity	Department/Institute	Year	ECTS (=28 hrs)
A. Project related competences			
International CoQA Workshop	Wageningen, Ethiopia, Benin	2009, 2010, 2011	4.2
PhD Trip	PDQ, UK	2012	2.8
Experiment! A workshop on experimental methods in social science and interdisciplinary research	CERES, MG3S	2009	1.5
Economic Institution of agricultural food in rural area	MG3S	2009	4
Advanced Econometrics (AEP 60306)	WUR	2009	6
Quantitative Research Methodology and Statistics (MAT 22306)	WUR	2009	6
Writing research proposal	MG3S	2009	4
Interdisciplinary Research: Crucial knowledge and skills	CERES	2010	1.1
B. General research related competences			
Information Literacy for PhD including Endnote	WGS	2009	0.6
Mansholt Introduction course	MG3S	2009	1.5
Mansholt Multidisciplinary research	MG3S	2009	1
Scientific Writing	WUR	2010	1.8
Techniques of writing and presenting scientific paper	WGS	2012	1.2
Presentation PhD Day	WASS	2012	1
'Constraints and challenges in governance and channel choice in tropical Agri-food chains: Evidences from pineapple supply chains in Benin'	CORAF, Cotonou, Benin	2010	1
'Market Channel Participation Of Small-Holder Pineapple Farmers In Benin'	Int. Academic Conference, Nevada, Las Vegas	2012	1
TOTAL			**38.7**