Coordination Mechanisms for Quality Improvement and Market Access in Ethiopian Potato Value Chains

Gumataw Kifle Abebe

Thesis committee

Thesis promoters
Prof. dr. S.W.F. Omta
Professor of Management Studies
Wageningen University

Prof. dr. R. Ruben
Professor of Development Studies
Radboud University Nijmegen

Thesis co-promoter
Dr. W.J.J. Bijman
Assistant professor, Management Studies Group
Wageningen University

Other members
Prof. dr. ir. P.C. Struik, Wageningen University
Prof. dr. ir. E.H. Bulte, Wageningen University
Prof. dr. M.P. van Dijk, UNESCO-IHE Institute for Water education, Delft
Prof. dr. M. Hanisch, Humboldt Universität zu Berlin, Germany

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

Coordination Mechanisms for Quality Improvement and Market Access in Ethiopian Potato Value Chains

Gumataw Kifle Abebe

Thesis

submitted in fulfilment of the requirement for the degree of doctor
at Wageningen University
by the authority of the Rector Magnificus
Prof. dr. M.J. Kropff,
in the presence of the
Thesis Committee appointed by the Academic Board
to be defended in public
on Tuesday 2 July 2013
at 4 p.m. in the Aula.

Gumataw Kifle Abebe

Coordination Mechanisms for Quality Improvement and Market Access in Ethiopian Potato Value Chains

PhD thesis, Wageningen University, Wageningen, NL (2013)

With references, with summaries in Dutch and English

ISBN: 978-94-6173-571-3

Acknowledgements

This PhD thesis would not have been possible without the help and guidance of several people around me. I would like to take this opportunity to offer my sincere gratitude to some of them.

First and foremost my cordial gratitude goes to my esteemed (co) promoters, Prof. Onno Omta, Prof. Ruerd Ruben, and Dr. Jos Bijman, for offering me the opportunity to take this PhD position at management Studies. Thank you very much Onno for your thoughtful guidance, warm encouragement, and critical comments, and making my stay at Management Studies very comfortable and memorable. I am highly indebted to Ruerd for his insightful comments in the course of my study. Your inputs have been very important for accomplishing my PhD study. Jos, you spent countless times discussing my research, reading my papers, and seeking different approaches to improve my work leading to this dissertation. I am very much grateful to you for all what you have done to me.

My special thanks goes to Dr. Admasu Tsegaye, who has been very instrumental to where I am today. Not only as a local supervisor for this PhD work but also in realizing my second degree. I wish you happiness and health. Also, I would like to express my sincere gratitude to Prof. Paul Struik who recruited me by coming to Ethiopia. I thank you very much for your trust in me in fulfilling the objectives of the COQA project and also for your great contribution to my work in the course of my PhD study. I am also very grateful to members of the CoQA team, particularly Aad van Tilburg, Anita Linnemann, Annie Royer, Meike Wollni, Hans van Trijp, Rob Schipper, Verena Bitzer, Willemien Lommen, and to the CoQA PhDs Bukelwa Grwambi, Djalal Arinloye, Engida Tsegaye, Nicodeme Fassinou Hotegni, Adane Tufa, and Harold Hounhouigan.

My stay at Management Studies in particular and Wageningen University in general would not have been comfortable without the support of caring and welcoming colleagues around me. I would therefore like to take this opportunity to offer my sincere appreciation to Andrei Cechin, Anne Pluijmaekers, Christos Kolympiris, Daniel Agbeko, Dimitrios Mitsopoulos, Domenico Dentoni, Emiel Wubben, Etriya Etriya, Eva Aviny, Frances Fortuin, Geoffrey Hagelaar, Gohar Isakhanyan, Hanieh Khodaei, Herman Kok, Ina Versteeg, Jacques

Trienekens, Janne Denolf, Johnnatan Boddie, Katjia Grekova, Leonie van Scherrenburg, Liesbeth Hijwegen, Lisa Ploum, Mark Mobach, Mark Wever, Mersiha Tepic, Nel Wognum, Paul van Beek, Peter Zuurbier, Rannia Nijhoff-Savvaki, Rita Abban, Ron Kemp, Silvia Perez Perdomo , Stefanie Broring, Stefano Pascucci, Tianjun Liu,Vincent Blok Waliou Yessoufou, Wilfred Schoenmakers, and Zhen Liu. Katjia, Janne, and Dimitrios, thank you for your inputs for the cover page. I would like to thank the Ethiopian student community at Wageningen University and my paranymphs Mequanint and Tsion for their support and friendship. I also would like to extend my gratitude to Wageningen School of Social Sciences and the Liason Office, particularly to Ineke van Driel, for the great cooperation I received in the course of this PhD study.

Back home, I would like to thank my colleagues and friends at Hawassa, particularly Bekele Bulado, Abraham Alano, Zewidu Zafu, Fitsum Assefa, Asfaw Wassie, Selamawit Abebe, Getnet Begashaw, Tariku Ejigu, Genet W/Michael, Asfaw Zewdie, Terefech Getachew, Yonas Estifanos, and Getachew Dinsa, and to my neighbors Yohannes, Meseret, Askale, Tadele, Million, Alemayehu, Tekalign, Getachew, and Engida, for their support. Also, I would like to thank my old friends Tadesse Fetahi, Girma Abebe, Kedir Hassen, Wondifraw Bogale, Abraham Lemma, Fentahun Mengiste, Kassaw Asmare, Destaw Asmare, and Damena Yilma for inspiring me to start this long journey. I would like to thank Bezawit Teshome and the staff of West Arsi zone, Shashemene, Shala, Shiraro, and Ambo Agriculture and Rural Development office for their support during the data collection.

Back to my family, first for all, I thank my mother and mother-in-law for keeping me in their Prayers. Also, I am very much grateful to my uncle Melaku Abebe and his family, Desta Wendimu, Michael Melaku, Alula Melaku, Abraham Melaku, Hiwot Melaku, and Asnake Adissie, for their support all the way.

I would never have been able to finish my study without the support of my wife Aregash and the family, Freselam, Henok, Rediet, and Sofonias. You deserve a special note in this dissertation. I know you have had a very difficult time all those years, thank you very much for your understanding and patience. Now I feel joy coming to you.

Finally, I gratefully acknowledge the Wageningen University International Research and Education Fund (INREF) and The Netherlands Organization for International Cooperation for Higher Education (NUFFIC) for financially supporting my PhD study.

Table of Contents

Chapter 1

Introduction

1. Introduction

Agriculture continues to be the major engine for the livelihood of smallholders in sub-Saharan Africa. However, smallholders face multiple challenges in gaining access to agricultural markets (Holloway et al., 2008; Staal et al., 1997). One of the main challenges negatively affecting commercialization in sub-Saharan Africa is lack of well-functioning agrifood value chains (Poulton et al., 2006). In the absence of such value chains, it is difficult to comply with the strict quality and safety requirements of high value markets, which is increasingly leading to the exclusion of smallholders from participating in these markets (Henson et al., 2005). Thus, enhancing smallholder commercialization[1] calls for developing sustainable agrifood value chains catering to national, regional, and international markets. Both the theoretical and empirical evidence suggests that access to improved technologies, institutional innovations (e.g., farmer organizations), and interlinked contracts with agribusiness firms (e.g., contract farming arrangements) are needed to induce smallholder commercialization in high value agricultural markets (Barrett, 2008; Poulton et al., 2010).

Smallholder commercialization also presupposes the availability of cash crops (Poulton et al., 1998). In this regard, potato has increasingly become an important cash crop for rural households in sub-Saharan Africa. According to the international potato center (CIP), potato is the third most consumed crop worldwide, after rice and wheat (http://cipotato.org/potato/facts). Also, future per capita consumption of potato is likely to increase because of the increasing demand for fast foods and consumers' awareness of potato as a healthy food. Potato contains high calorie, dry matter, protein, essential vitamins, minerals, and dietary fiber content among major food crops (Storey and Davies, 1992). Because of its high nutritional content and its high yield, potato is considered one of the key crops for food security in the densely populated regions of sub-Saharan Africa. This means that there are potentially good prospects for potato growers to enhance their commercialization.

[1] Commercialization in this thesis is used to refer to making use of market opportunities by smallholders, e.g., by growing market-oriented crops rather than growing only for own consumption.

However, improving smallholder commercialization requires coordinated action between several value chain actors in order to align the quality produced by smallholder farmers with the quality demanded in the national, regional, and international market. Nowadays, high-value markets for domestic consumption are the fastest-growing agricultural markets in many developing countries (World Bank, 2008). The welfare impacts of this growth, however, depend on the extent to which smallholders participate in these markets, the availability of market infrastructure, and institutional innovations (e.g., collective action through producer organizations, contract farming arrangements). The increasingly stringent sanitary and phytosanitary standards required in the national and global markets have brought a significant change in the organization of agrifood chains (Ménard and Valceschini, 2005).

Firstly, from the supply side, quality has become the key variable in the marketing strategies of agrifood value chain actors. Thus, when smallholders want to participate in these chains, they have to make specific investments and coordinate their activities with other actors in the downstream parts of the value chain. Indeed, this is a big challenge for the majority of smallholders in sub-Saharan Africa. Addressing smallholders' challenges requires joint public and private efforts in policy (e.g., food safety legislation), research, and value chain development around smallholders. The presence (or development) of efficient value chains is one of the key requirements for 'agriculture-for-development' indicated in the 2008 World Development Report (World Bank, 2008). This report further highlights that the private sector can improve smallholder commercialization through driving the organization of value chains involving smallholders and commercial farms. Likewise, the public sector can promote smallholder commercialization through enhancing capacity and correcting market failures (e.g., by supplying agricultural technologies, inputs, etc.). Commercialization also opens new opportunities for smallholders to foster innovation. Thus, enhancing smallholders' participation in integrated value chains is dependent on the availability of technical support, capacity building through knowledge sharing mechanisms, farmer-to-research interaction, farmer-to-farmer interaction, and farmer-to-buyer interaction (World Bank, 2008).

Secondly, on the demand side, there has been an increasing dominance of large retailers in setting the quality requirements that suppliers of food products have to comply with, including suppliers from developing countries. These retailers are increasingly dominating national, regional, and international markets by setting standards for food quality and safety (Reardon and Swinnen, 2004). These standards are major challenges for smallholders, which

means they have a high chance that they will be left out from high value markets unless they get support. Nonetheless, given the right supports (e.g., inputs, credit, extension services, technology adoption) and contract incentives, smallholders can participate successfully even in highly competitive global value chains (Minten et al., 2009).

In sum, the modern market has brought both challenges and opportunities for smallholders. In view of these challenges for smallholder commercialization, the present study aims to gain insights into the factors affecting smallholders to improve quality and market access by analyzing their relationship with upstream (and downstream) actors and thus to generate information relevant for the development of sustainable value chains in the potato sector. More specifically the thesis aims to explore:

- *product or technology related quality alignment*[2] *problems by analyzing the interactions between smallholder farmers and their upstream actors; and*
- *value chain related quality alignment problems by analyzing interactions between farmers and downstream actors (seller-buyer relationships).*

The remainder of this introduction chapter is organized as follows. An overview of the potato crop in Ethiopia is presented in section 1.1. Section 1.2 provides the theoretical framework of the study, followed by contributions of the thesis to the literature in section 1.3. Section 1.4 highlights the main research questions to be addressed. The data and methods and the outline of the thesis sections are presented in sections 1.5 and 1.6.

1.1 Overview of the Ethiopian potato value chain

The current economic policy of Ethiopia, Plan for Accelerated and Sustained Development to End Poverty (PASDEP), is aiming at shifting of farmers from traditional (semi-subsistence) farming practices to market-oriented production systems (Jaleta and Gardebroek, 2007). As a result, potato is considered one of the spearheads of agricultural policy by the Ethiopian policymakers because of its potential for food security, export, and income generation.

[2] In this study, quality alignment refers the matching of quality preferences between two or more actors in the potato supply chain

Potato ranks first among the vegetable crops, and is a rapidly expanding crop in Ethiopia. However, despite favorable government policies, weather conditions, and good strategic location to trade with the Middle East and neighboring countries, the productivity and market performance[3] of the potato crop continues to be low. Over the last two decades, the increased in potato production has been realized from area expansion (Gildemacher et al., 2009) (Figure 1.1). This means that modern varieties that could have enhanced smallholder productivity and commercialization have not been used or these varieties have not been available for or, if available, have not been used by smallholders. As a result, the large majority of potato production has been sold in the national market.

Recently, however, smallholders have recognized the importance of the potato crop to improve commercialization. Furthermore, the export of potato has shown substantial growth since 2006 (Figure 1.2). Overall, if efficient value chains there availability, there is a good chance that the potato crop will become one of the main crops enhancing smallholder commercialization in the country, in addition to the traditional crops like coffee and oil seeds.

There have been, however, efforts by the Ethiopian Institute of Agricultural Research (EIAR) to improve the performance of the potato sector. As a result, EIAR (with the help of international research organizations) released around 18 potato varieties in the last two decades. Nonetheless, the adoption rate and area cultivated to grow these varieties (by ware potato growers) have been low. Instead, smallholders continue growing the 'local' [4] varieties (Gebremedhin et al., 2008). The often explanation for the low performance of the Ethiopian potato sector has been poor seed supply systems. However, this claim has not been empirically substantiated from the perspective of ware (consumption) potato farmers.

[3] In this thesis low performance refers to smallholders' limited access to high value markets such as to supermarkets, processors, or export markets.
[4] Generally, Ethiopia does not have indigenous potato varieties. Potato was introduced in Ethiopia around 1858. However, there is no document showing how and when these 'local' varieties currently used were introduced.

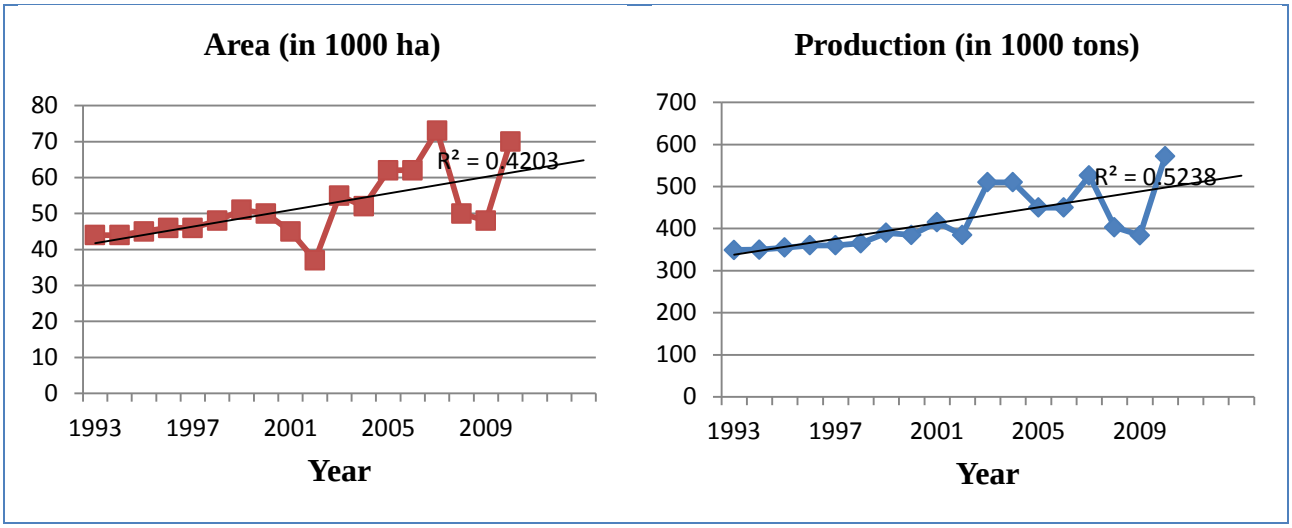


Figure 1.1 Potato area expansion and production in Ethiopia between 1993 and 2010 (FAOSTAT, 2013)

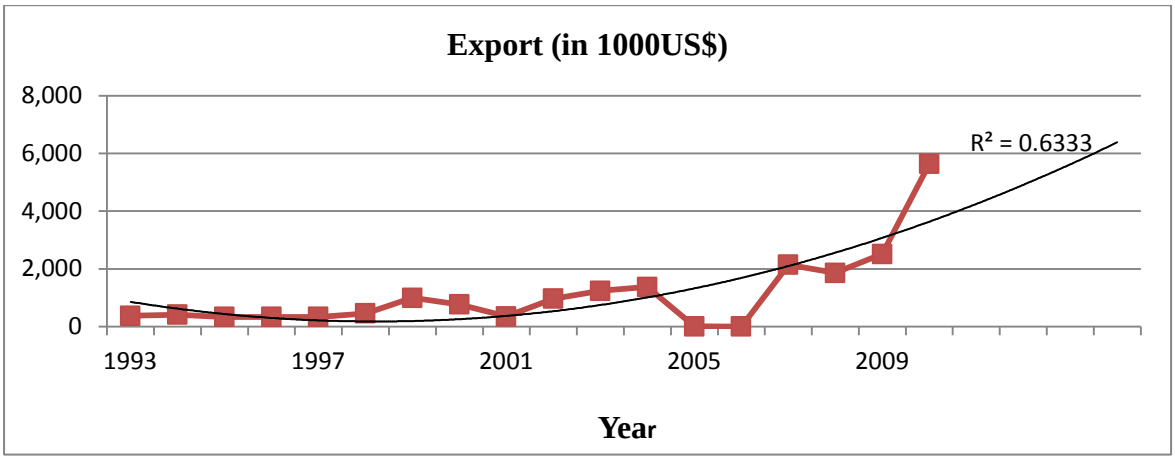


Figure 1.2 Potato exports in Ethiopia between 1993 and 2010 (FAOSTAT, 2013)

1.2 Theoretical framework

To analyze smallholders' upstream and downstream interactions, the concept of institutions is important for this thesis.

North (1994) defines institutions as 'the humanly devised constraints that structure human interaction. They are made up of formal constraints (rules, laws, constitutions), informal constraints (norms of behavior, conventions, and self-imposed codes of conduct), and their

enforcement characteristics. Together they define the incentive structure of societies and specifically economies' (p. 360). The concept of institution has become a popular domain of research with the advent of the New Institutional Economics (NIE) (Coase, 1937; Williamson, 2000). NIE is a multidisciplinary field of research that has emerged in response to the shortcomings of the neoclassical economics approach in which economic agents were assumed to operate in a frictionless market environment (such as perfect information, zero transaction costs, and full rationality). The NIE approach to economic development provides the framework both to explain the determinants of institutions and their evolution over time, and to evaluate their impact on economic performance, efficiency, and distribution (Nabli and Nugent, 1989).

However, by influencing transaction costs and coordination possibilities, institutions can have the effect of either facilitating or retarding economic exchanges (Kherallah and Kirsten, 2002). The NIE framework operates at two levels of analysis: macro and micro levels (Williamson, 2000). At the macro level of analysis, NIE deals with the institutional environment affecting the behavior and performance of economic actors. At the micro level of analysis, NIE deals with the institutional arrangement (or governance structure) in which individual transactions are embedded.

Although NIE has several perspectives, one of the popular theories is transaction cost economics, which hypothesizes institutions as transaction cost-minimizing arrangements. Following Coase (1937), Williamson (1979), and North (1990), the concept of transaction costs in the economic analysis of institutions has become a rapidly expanding domain of research, particularly with respect to the analysis of interactions between institutions and the organization of economic activities. Transaction costs serve as the unifying concept in analyzing the efficiency of alternative institutional arrangements. Therefore, transaction cost economics has advanced the explanation of contractual relations from ex ante incentive alignment to ex post safeguarding and adapting of contracts. The major advancement of the transaction cost economics theory relates to the identification of principal dimensions in which transactions differ, principal attributes for describing institutional arrangements (governance structures), and a discriminating match in aligning transactions with governance structures (Williamson, 2000). According to the transaction cost economics theory, the behavior of the trading partners and the nature of transactions determine the appropriate institutional arrangements. Transaction costs are caused by behavioral factors (bounded

rationality and opportunism) and characteristics of the transaction (asset specificity, uncertainty, and frequency) (Williamson, 1979). Thus, efficient value chain organization presumes an alignment between the transaction (with its specific characteristics) and the institutional arrangement (with its specific attributes).

The main purpose of this thesis is to analyze the effect of different institutions (institutional environment as well as institutional arrangements) on quality alignment and the implications for smallholder commercialization.

1.2.1 Institutional environment

Parts of the institutional environment are research, extension, credit, public quality standards, and the functioning of the legal system protecting investments. Also, the institutional environment includes informal institutions such as social networks. Thus, the first order of economizing transaction costs is to get the institutional environment right (Williamson, 2000). In this thesis, two important institutions are considered at the level of the institutional environment – the agricultural knowledge and innovation system (AKIS) and the institution of middleman.

Regarding the AKIS, the thesis focuses on the role of research, extension, credit, farmer organizations, farmer training centers, NGOs, and downstream actors in technology adoption. There are generally two views regarding AKIS in the literature. One view assumes farmers as passive recipients of new technologies; thus, technology adoption process follows a top-down (unidirectional) approach. The other view (participatory innovation approach) considers farmers as active innovators. The underlying notion of the participatory innovation approach is that farmers have an intimate knowledge of their local environment, conditions, problems, priorities and criteria for evaluation as part of their farming routine (Sumberg et al., 2003). The participatory innovation approach also acknowledges that agricultural research and technology adoption contain divergent objectives of several actors (Biggs, 1990). Thus, analysis of the role of AKIS is particularly important in Ethiopia in which smallholder commercialization depends on the availability of new technologies (such as modern varieties) that are acceptable by the national, regional, and international customers. The main hypothesis of the AKIS perspective is that a participatory innovation approach can lead to improved relationship between research institutes and farmers, thereby including farmer

knowledge and preferences in setting research priorities, and thus enhances the uptake of newly developed varieties.

Another aspect of the thesis regarding the institutional environment is the role informal institutions in trade relations and smallholder commercialization. In general, informal institutions refer to self-governing social networks available to participants in their economic/social interactions (Dixit, 2009). Informal institutions can facilitate search and information. Informal institutions rely on a set of shared norms that regulate how transactions are carried out in a repeated manner and what sanctions need to be imposed against non-compliance. The embeddedness of transactions in a social context can reduce transaction costs by restraining agents from opportunistic behavior, thus increasing the likelihood of contract compliance (Fafchamps, 2006), and by facilitating information exchange (Platteau, 2000). The thesis focuses on one particular institution, that of the middleman, and examines the role of social ties in trading relations. Most transactions that involve middlemen in the potato value chain appear to be highly embedded in the social context. Thus, the thesis opted to analyze the role of middlemen at a higher level rather than merely considering them as economic agents and thus analyzing their role at the level of institutional arrangements.

1.2.2 Institutional arrangements

The type of institutional arrangements is important in a world of incomplete contracts in order to make contractual relations stable, to create specific mechanisms for coordinating activities, to organize transactions, and to solve disputes in agrifood chains (Ménard, 2004). Institutional arrangements (governance structures) can infuse order in a relationship where potential conflict threatens to undo opportunities to realize mutual gains (Williamson, 1999). Fundamental to the choice of institutional arrangements is the presence of transaction costs, which are caused by the attributes of transactions and the characteristics of human behavior. The incompleteness of contracts ex ante due to bounded rationality can lead to costly renegotiations ex post and can provide room for opportunistic behavior. According to Williamson (1999), the type of institutional arrangements required to guard against contractual hazards vary by incentive intensity, administrative controls, and contract law regime. Generally, institutional arrangements can take different forms – spot market, hybrid, or hierarchy. More integrated institutional arrangements are associated with transactions that

are characterized by high uncertainty (e.g. quality uncertainty), frequent exchanges, and transaction specificity of investments.

Agricultural transactions display a broad range of institutional arrangements because of the location-specific nature of the investments and the perishability of agricultural products (Masten, 2000). Thus, the search for appropriate institutional arrangements in agricultural transactions to shape and monitor economic activities will continue to generate a flow of theoretical models and empirical studies (Ménard, 2004). In this thesis, four types of institutions (spot market, farmgate [5]transactions, trust-based transactions, and contract farming arrangement) are explored in the relationship between farmers and downstream actors.

1.2.3 Relationship between institutional environment and institutional arrangements

The institutional environment, which consists of formal and informal institutions, can affect quality improvement activities and thus quality alignment on a number of aspects: on the type of organizational arrangement chosen, on the way specialization in agriculture can be developed, on the type of contracts that connect parties in the value chain, or on the resulting contractual hazards and contractual costs (Ménard and Valceschini, 2005).

In the Ethiopian potato value chain, the institutional environment can have a significant influence on the type of institutional arrangements between farmers and downstream actors. The presence (or enforcement) of quality standards or quality control mechanisms can facilitate information exchange in the seller-buyer relationship. When there is a formal quality control system, contractual hazards related to quality can be solved through public certification of the final product. This economizes on both the amount of private 'reputational capital' necessary to guarantee quality to the buyers (or consumers) and the extent of quality controls along the value chain (Raynaud et al., 2005). However, when formal mechanisms are not present (or enforced), value chain actors may have to invest on reputational capital (trust) or on other type of arrangements to control quality. Likewise, informal institutions, such as the institution of middleman, can affect contractual relations between sellers and buyers, for instance, by excluding new entrants from participating in the market, by applying price

[5] Farmgate in this thesis is used to refer to a type of arrangement between ware potato farmers and traders in which transaction takes place at the farmers' field mostly when potatoes are still in the field.

collusion (McMillan and Woodruff, 1999), or by changing the relative bargaining powers of buyers and sellers (Fafchamps, 2000). Relationships between the concepts are presented below (Figure 1.3).

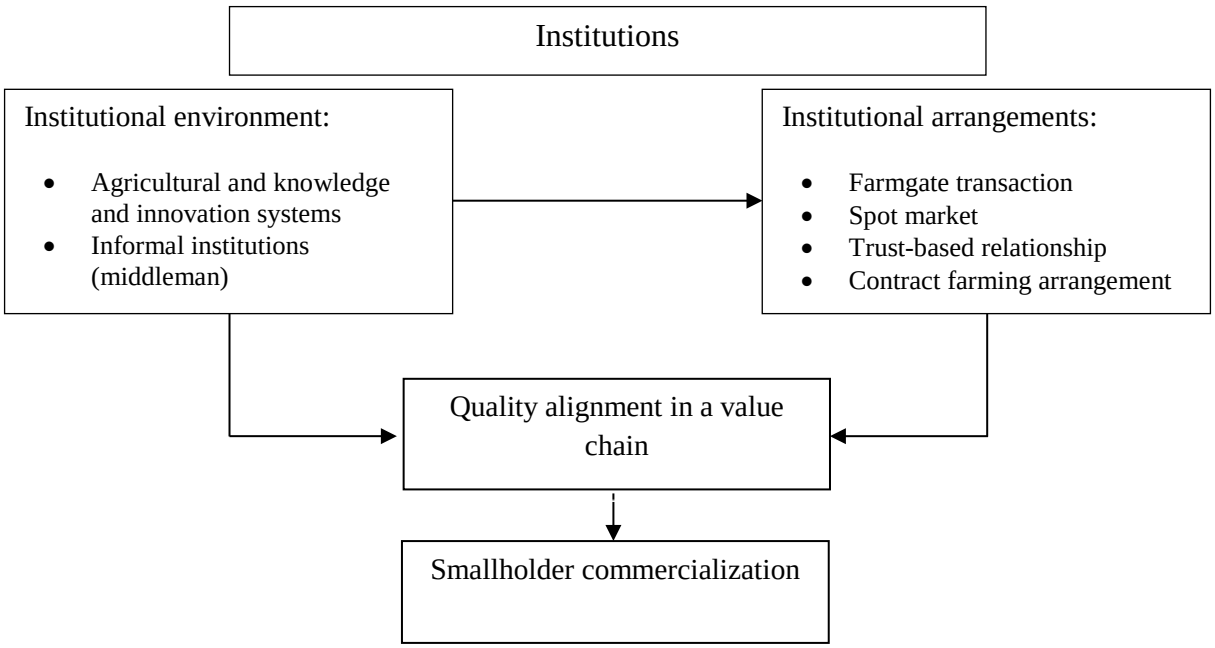


Figure 1.3 Conceptual framework

1.3 Contributions to the literature

The present study offers several contributions to the literature.

Firstly, this study has conceptualized quality alignment (and smallholder commercialization) as a factor of institutional environment (formal as well as informal institutions) and institutional arrangements and their interactions. In doing so, it shows the multidimensional nature of smallholders' problems related to quality improvement and market access in the context of less-developed agrifood chains. Secondly, the thesis provides specific insights and identifies the main factors affecting quality alignment by paying due attention to the upstream-related (e.g., variety choice) and downstream-related relationships (choice of institutional arrangement) of ware (consumption) potato farmers. Previous studies related to potato in Ethiopia and other East African countries largely focused on the problems related to the supply side of seed potatoes (Gildemacher et al., 2009; Hirpa et al., 2010; Ortiz et al.,

2013; Schulte-Geldermann et al., 2012). Thirdly, the thesis expands the understating regarding the factors influencing smallholders' adoption decision by focusing on a broader set of determinants than is usually done in adoption studies. The present study demonstrates that farmers' assessment of production- and market-related attributes of existing (local) varieties can influence farmers' decision to adopt new varieties. Furthermore, the thesis provides further arguments for the need to include farmers and downstream value chain actors in the innovation process. Fourthly, the thesis offers empirical analysis on how interpersonal relationships and social networks can affect the efficiency of economic exchanges in the context of less-developed agrifood chains. Most work to date emphasis the role of middlemen from the perspective of search criteria. But in this era of modern economy where smallholders are increasingly getting access to a mobile phone, evaluating the role of middlemen from only information and search criteria appears to be limited. This thesis provides arguments by analyzing the role of middlemen in enhancing or hindering smallholder commercialization and thus contributes to the general discussion in the literature regarding the impact of social networks on the welfare of smallholders. Lastly, the thesis provides insights into the effectiveness of contract farming schemes by analyzing the attractiveness of different contract design attributes from the perspective of smallholders. In doing so, the thesis provides managerial implications on designing sustainable contract farming schemes.

1.4 Research questions

This thesis is part of the research programme "Co-Innovation for Quality in African Food Chains" (CoQA), which is a collaboration of Wageningen University with Hawassa University and Addis Ababa University in Ethiopia, University of Abomey-Calavi (Benin) and the University of Fort Hare (South Africa). The CoQA programme studies quality improvement options in three African food chains: pineapple in Benin, deciduous fruit in South Africa and potato in Ethiopia. The main objective is to analyse and design co-innovations for quality improvement in order to support smallholder producers in tailoring the quality of their products to the demands of their national and international supply chain customers, thus strengthening smallholder market access and competitiveness. The CoQA program has been funded by the INREF fund of Wageningen UR. (For further information, see www.coqa.nl). Within the CoQA framework, the present study focuses on analyzing the

role of institutions on quality improvement and market access in the context of Ethiopian potato value chains.

Potato is an inherently bulky, costly (due to large amount of inputs required), and perishable crop that can easily lose its quality during the process of harvesting, storage, distribution and marketing (e.g., due to physical damage, physiological decay, and/or poor storage conditions). Coordination is therefore necessary to maintain the quality required by national, regional, and international customers, and to minimize transaction costs arising from information asymmetries, high transportation costs, and high market risks.

In addition to its bulkiness and perishability, potato is also a multi-attribute crop in which the decision to grow is dependent on several factors. For instance, farmers can choose between multiple varieties. In this situation, the role of research and extension, in terms of developing and disseminating, the right varieties is important. Likewise, the manner in which transactions are coordinated between farmers (sellers) and downstream actors (buyers) can influence quality alignment because of differences in individual incentives to improve product quality. Thus, Chapter two explores the main factors influencing quality alignment in the Ethiopian potato value chain by addressing the following research question.

Research question 1 (RQ1): *How do farmer and trader preferences for specific quality attributes and coordination mechanisms in farmer-trader relationships affect the alignment of quality in the Ethiopian potato value chain?*

Relatedly, supporting the adoption of new technologies is one of the most popular policy strategies in developing countries to improve quality of agricultural products and smallholder commercialization. Though improved quality attributes related to production (e.g., yield, disease resistance, etc.) might be a reason for smallholders to adopt new technologies, they are usually reluctant to do so. An often mentioned reason is that farmers are risk averse; therefore, they are less open to technological change and innovation. This type of reasoning seems to be dominating the debate around the adoption of improved potato varieties in Ethiopia. Thus, Chapter three goes further to understand the specific factors leading to low adoption by analyzing the relationships between adoption decision and the role of the agricultural knowledge and innovation systems and potato farmers' perceptions toward the local varieties.

Research Question 2 (RQ2): *How do the agricultural knowledge and innovation system and farmers' perception of local varieties affect the adoption of improved potato varieties?*

The institutional environment can affect downstream relationships in many ways. The institution of middleman is one of the main informal institutions that has long presence in many countries, particularly in trading relationships between smallholders and traders. Several studies regarding middlemen have argued that middlemen can facilitate smallholders' commercialization by solving information access problems (e.g., about price, market outlets, etc.). However, in the modern economy in which most smallholders living in remote areas are increasingly having access to information through mobile phones, the function of middlemen needs to be re-examined. Thus, Chapter four questions the role of middlemen as an appropriate institution in resolving potato farmers' marketing problems by addressing the following research question.

Research question 3 (RQ3): *Which factors do influence farmers' decision to use middlemen in their trading relations, and what is the economic impact of such relationship?*

Chapter five entirely focuses on one institution (contract farming), and studies detailed contractual relations enhancing smallholder commercialization. Contract farming refers to an agreement between a farmer and an agribusiness firm where the farmer produces a particular quantity and quantity of an agricultural product and the firm has a commitment to buy it. Such interlinked contracts can increase smallholders' income because it allows farmers to grow high value crops. Likewise, this arrangement benefits agribusiness firms as they receive high quality products and timely supply. Although these contractual arrangements can be mutually beneficial, in practice they often encounter multiple commitment problems. Thus, improving insights into the details of contractual arrangements can help build better contractual relations between smallholders and agribusiness firms. Previous studies have provided a wide range of analysis regarding the (positive) welfare impact of contract farming and its potential to enhance smallholder commercialization. At the same time, there have been many reports of contract non-compliance and free-riding by either parties. Thus, Chapter five aims to analyze the attractiveness of different contract design attributes in smallholders' decision to participate in a contract farming arrangement.

Research question 4 (RQ4): *Which contract attributes do motivate smallholders to participate in a contract farming scheme?*

1.5 Data and methods

To answer the research questions outlined above, the study used data collected through surveys and secondary data sets (the details are presented in each of the chapters). The study was carried out in Ethiopia in three areas: West Arsi zone (in the Rift Valley region), West Shewa zone, and Addis Ababa (Figure. 4). West Shewa zone in which part of this study was conducted is located 125 km West of Addis Ababa. This region was chosen due to seed potato farmers experience working under a contract farming arrangement. Thus, data used in Chapter five were collected from this region. The major part of the study took place in the West Arsi zone (located some 250 km to 300 km) south of Addis Ababa. This area is located in the Rift valley region, and is the main ware (consumption) potato producing region in the country. Based on data from this study (Chapter two), more than 65% of the potato in the Addis Ababa (the capital) wet market were supplied from this region. Data collected from this region and that of Addis Ababa were used to answer RQ1, RQ2, and RQ3 (Chapters two, three, and four). Chapter two is also partly based on a price data set, which was collected from one of the main potato spot markets in Ethiopia, Shashemene. The data were analyzed using several techniques (details are discussed in each of the chapters).

Figure 1.4 Study areas in Ethiopia

1.6 Outline of the thesis

Chapter two empirically explores the main factors influencing quality alignment in the potato value chain. Chapter two uses survey data collected from 346 (ware) potato farmers, 34 downstream actors, and two years weekly price data. Chapter three goes further to explain the underlying causes of low adoption for improved potato varieties. More specifically, Chapter three provides answers to causes of low adoption by analyzing the relationship of

adoption decision and the role of agricultural knowledge and innovation systems (AKIS) and smallholder farmers' quality assessment of local varieties. To do so, Chapter three uses the data collected from 346 (ware) potato farmers. Chapter four identifies the main factors that affect farmers' decision to trade through middlemen and the economic impact of such relationship. Chapter four also uses the same data set as Chapter three. Chapter five analyzes the attractiveness of different contract design attributes that affect smallholders' motivation to participate in a contract farming scheme. Chapter five uses data collected (based on experimentally generated questionnaire) from 144 seed potato farmers and analyzes smallholders' preferences for contract design attributes (contract terms and conditions). Chapter six discusses the main results, provides the main conclusions, highlights the main contributions to the literature and the implications for practices, and outlines directions for further research.

Chapter 2

Factors influencing the alignment of quality preferences in the Ethiopian potato value chain

This chapter has been submitted to the American Journal of Potato Research as 'Abebe, G.K., Bijman, J., Pascucci, S., Omta, O. and Tsegaye, A. Factors influencing the alignment of quality preferences in the Ethiopian potato value chain'.

2. Factors influencing the alignment of quality preferences in the Ethiopian potato value chain

2.1 Introduction

Vertical coordination in agrifood chains has become increasingly important in recent days due to consumer demand for higher quality product, and because the competition in national and global markets has shifted from price-based to quality-based (Henson and Jaffee, 2008; Swinnen and Maertens, 2007). Retailers in the international agrifood chains have taken up the coordination role in aligning quality, for instance, by imposing their own food quality and safety protocols (Narrod et al., 2009). For domestic markets in developing countries, aligning quality is more difficult as value chain actors tend to operate independently. With the rise of an urban middle income class in developing countries, there is an increasing demand for high quality foods (Weatherspoon and Reardon, 2003). Coordinated action (in a value chain) is needed, not only for operational efficiency (Lee et al., 1997; Stank et al., 1999) but also for quality improvement and quality alignment. We define quality alignment as the matching of preferences among value chain actors.

Potato is increasingly demanded in developing countries because of the growth in fast food restaurants (Stewart et al., 2004) and population (Pretty et al., 2003), and because consumers perceive potato as a healthy food (Jemison et al., 2008). In the context of Ethiopia, aligning quality is more difficult in the potato value chain at least for the following reasons. Firstly, the production of potatoes is more complex than the production of other crops because of the two stage production processes and agro-ecological factors. While for most crops the production of starting material, such as seeds and plantlets, is concentrated on a few, usually large farms, the production of seed potatoes is highly dispersed and often agro-ecological specific. Secondly, producers of seed potatoes are often disconnected from producers of ware potatoes, because ware potato growers use either their own (farmer-saved) seed or seed sourced from other ware potato growers, not from the specialized seed potato growers. The potato sector in Ethiopia is thus a clear example of the disconnection between (specialized) seed potato growers and ware potato growers. Thirdly, the lack of common quality grades (standards) or other formal mechanisms make the alignment of quality a challenge.

The Ethiopian potato sector consists of four main actors, namely research institutes, seed potato growers, ware potato growers, and traders. However, despite the availability of several improved varieties (IVs) released by the research institutes, the traditional or local varieties (LVs) remain the dominant commercial variety in the Ethiopian wet potato market. This implies a misalignment between the (potato) quality supplied by research institutes (variety development) and quality preferred by farmers and traders (variety choice). Diverging objectives and preferences (regarding specific quality attributes) among different actors make the alignment of quality a complex and challenging task.

The objective of this study is to provide insights into the factors that influence the alignment of quality in the Ethiopian potato value chain. Using a value chain perspective, the study specifically focus on (1) farmer and trader preferences for specific quality attributes in their variety choice; and (2) the coordination mechanisms currently used in farmer-buyer relationships. The study seeks to know whether and how differences in preferences among value chain actors affect quality alignment or misalignment. In addition, the study seeks to understand whether and how different types of coordination mechanisms in the farmer-buyer relationship affect quality alignment.

Using an interdisciplinary research approach (combing economics and marketing concepts and farmer knowledge), this study attempts to broaden the understanding of the factors that influence the alignment of quality preferences in food value chains in developing countries, such as the Ethiopian potato value chain. There have been many studies on the Ethiopia potato sector but they mainly focused on seed potato supply systems (Gildemacher et al., 2009a; Gildemacher et al., 2009b; Hirpa et al., 2010; Hirpa et al., 2012; Ortiz et al., 2013; Schulte-Geldermann et al., 2012). This study focuses on the ware potato value chain by analyzing the effect of ware potato farmers' and traders' preferences for specific quality attributes and the effect of different types of coordination mechanisms on ware potato farmers' incentive to improve quality. The study addresses the following research question:

RQ1: *How do farmer and trader preferences for specific quality attributes and coordination mechanisms in farmer-trader relationships affect the alignment of quality in the Ethiopian potato supply chain?*

In exploring potential quality alignment problems related to variety choice, the study first identifies currently used local and improved potato varieties and characterize them into production-related and market-related quality characteristics. The study then assesses farmer and trader preferences, assuming these preferences influence their variety choice. To explore potential solutions for quality alignment problems in the farmer-trader relationship, the study identifies the type of coordination mechanisms and analyzes their effect on smallholder farmers' incentive to improve quality.

The rest of the chapter is organized as follows. Section 2.2 presents the conceptual framework, followed by data and methods in section 2.3. Section 2.4 provides the results and discussion. Section 2.5 presents the conclusions.

2.2 Conceptual framework: quality alignment

Quality alignment and misalignment can be influenced by several factors. First, compatibility of objectives of value chain actors is needed for quality alignment (Spinelli and Birley, 2002). Whether the objectives of actors involved in the relationship are similar or different, the attainment of one's objectives should not conflict with the attainment of others' objectives (Wong, 1999). However, compatibility of objectives is not enough to obtain quality alignment. Second, quality alignment requires coordination in the value chain. Coordination is a combination of information exchange and specific decision-making processes (Bijman and Wollni, 2009; Gagalyuk et al., 2010). Without information exchange, actors cannot know each other's preferences, and without a proper decision-making process, the preferences of difference value chain actors cannot be aligned. Third, quality alignment can be influenced by the diversity of specific quality attributes. Finally, quality alignment can be influenced by the type of institutional arrangements used in governing transactions between value chain actors.

2.2.1 Variety development and quality preferences

One area of potential misalignment considered in this study relates to specific quality attributes used in variety development and quality attributes that are preferred by farmers and buyers. When IVs released by research institutes do not have both the production-related and

market-related quality attributes as preferred by farmers and buyers, quality misalignment is present. The question then is which quality attributes do influence farmers and traders variety choice?

As a product consists of multiple attributes (Lancaster, 1966), quality can be decomposed into intrinsic and extrinsic attributes (Steenkamp, 1989). Intrinsic quality attributes relate to the characteristics of the physical product, which cannot be changed without altering the product, while extrinsic quality attributes relate to the intangible characteristics of the product, such as price, brand name, and place of origin. Defining quality in a value chain is problematic as different chain actors may perceive quality differently based on what they demand from and like about a particular product (Ruben et al., 2007).

2.2.2 Coordination mechanisms

Another potential area of misalignment considered in this study relates to the type of coordination mechanisms in farmer-buyer relationships. Coordination is defined by Malone and Crowston (1994) as 'the process of managing dependencies between activities' (p.90). Coordination problems could arise from conflicting objectives, disagreements over domain of decisions and actions, and differences in perceptions in joint decision-making between chain actors (Kanda and Deshmukh, 2008). Thus, the decision making process and the extent of information exchange is expected to affect the alignment of quality along the value chain.

In reducing information asymmetry (and thus to improve coordination), value chain actors may use different quality signaling and screening techniques. One crucial decision problem for the seller is to decide on how to provide information on quality to uninformed buyers. The literature provides different signaling techniques such as third-party protocols and procedures (standards) and product differentiation through branding and reputation (Raynaud et al., 2005; Sporleder and Goldsmith, 2001). Quality standards can facilitate coordination between farmers and downstream actors by carrying information on quality attributes and minimizing buyers' search costs (Digal, 2005; Raynaud et al., 2005). However, quality standards are absent in many developing countries since the liberalization of domestic markets and the abolishment of state marketing institutions (Beynon et al., 1992). Furthermore, it can be costly for the private actors to implement formal quality assurance systems, as such systems heavily rely on documentation of production processes and practices and third-party auditing

and certification (Holleran et al., 1999). In the absence of quality signaling techniques, buyers may use different quality screening mechanisms to lower search costs for quality (Diehl et al., 2003). It is interesting to know how information about potato quality is transmitted among value chain actors. Thus, this study addresses the question 'What type of quality signaling and screening mechanisms are used in the potato value chain to optimize information exchange and thus to improve the alignment of quality?'

Different institutional arrangements can be used to economize on transaction costs and facilitate economic exchanges between farmers and downstream actors and between downstream actors (e.g., between collecting wholesalers and stationed wholesalers). Transaction cost economics focuses on three types of institutional arrangements – spot market, hybrid and hierarchy (Williamson, 1985). While under a spot market arrangement price is the sole coordination mechanism, the hierarchy form puts all the production and marketing stages of a value chain under the control of one entity (Hobbs, 1996). In between is a hybrid mode, which may take different forms, such as written contracts and relational contracts.

When coordination is handled in a spot market arrangement, buyers may face high quality uncertainty due to the difficulty of measuring the performance of sellers (e.g., due to unobservable quality characteristics such as residuals). Quality uncertainty is a major source of risk in agricultural transactions (Wolf et al., 2001) and increases the buyers' willingness to engage in a more integrated form of coordination (Goodhue, 2011). When quality uncertainty is high and a formal quality control mechanism (e.g., third party certification) is present, it could be more economical for value chain actors to use a (spot) market type of institutional arrangement (Raynaud et al., 2005). A spot market is defined as the absence of a seller-buyer relationship. When quality uncertainty is high and third party certification is not present, value chain actors may choose non-spot market type of institutional arrangements, such as formal contracts and trust-based relationships. A trust-based relationship implies that the other party is benevolent and that contracting parties will not be victims of any type of contractual hazards. The sources of trust may relate to institutional factors such as the ability of the formal structures to impose sanctions when trust is breached (Humphrey and Schmitz, 1998), to characteristics or reputation of the transacting parties (Masuku and Kirsten, 2004), or to knowledge obtained through repeated interactions (Nohria and Gulati, 1996). In a formal contract, coordination is achieved by specifying detailed roles and responsibilities,

procedures for monitoring, and penalties for performance noncompliance of contracting parties (Poppo and Zenger, 2002). Coordination through a trust-based relationship or a formal contract thus enhances the incentive to improve quality, because this type of arrangement introduces predictability into production systems and allows participants to allocate resources and share risks with greater confidence (Hueth et al. 1999).

In general, a non-spot market type of institutional arrangement, often combining formal and informal mechanisms, has been claimed to be superior for obtaining consistent quality (Jang and Olson, 2010), for providing incentives for higher quality (Goodhue, 2011), for inducing investment in specific assets leading to improved quality (Raynaud et al., 2005; Reardon et al., 2009), for facilitating risk sharing (Sykuta and Parcell, 2003), and for preventing the problems of asymmetric information regarding specific product attributes (Hueth et al., 1999; King et al., 2007).

2.3 Data and Methods

Because different value chain actors define quality differently, the study systematically analyzes quality using two categories of quality attributes (of ware potatoes): production-related and market-related. Attributes like yield, disease tolerance, maturity period, drought resistance, and crop management intensity are production-related because they determine production practices. Tuber size, stew quality, cooking quality, color, shape, and shelf life are market-related attributes because they determine sales options. For potatoes, variety type largely determines intrinsic quality attributes (Howard, 1974; Jemison et al., 2008; Long et al., 2004). However, objective information on the quality attributes of local varieties is lacking. In situations where no objective quality information is available, farmer knowledge can be used to describe the quality of different varieties (Cavatassi et al., 2011). Thus, the study first addresses the question ‘How do ware potato farmers characterize currently used potato varieties (both LVs and IVs) in terms of production- and market-related quality attributes?’

The extent of quality alignment in the potato value chain is measured by the extent to which IVs released by research institutes are being adopted by ware potato farmers, and the extent

to which these varieties are liked by buyers at the different stages of the chain. To do so, the preferences of research institutes are measured by their research priorities; the preferences of farmers are measured by their production decisions; and the preferences of traders are measured by their preferences for specific quality attributes.

2.3.1 Survey

Farmers' survey

The study was carried out in the spring of 2011 among 350 ware potato farmers in the Rift valley region of Ethiopia. Although potatoes can be produced in different parts of the country, this study focuses on the Rift Valley region for two main reasons. Firstly, ware potato farmers in the Rift Valley region are the main suppliers of ware potatoes to the major cities of Ethiopia. For instance, the Shashemene spot market, in the center of the study region, is the main trade hub of ware potatoes in Ethiopia (Emana and Nigussie, 2011; Tefera et al., 2011). Secondly, to characterize the different potato varieties, it is necessary that the farmers in the survey have the same understanding of the existing varieties. In Ethiopia, variety names lack standardization and are often attached to local languages (Cavatassi et al., 2011). Thus, focusing on one region avoids problems arising from confusion of variety names.

The ware potato farmers were randomly selected from the land ownership register obtained from the Office of Agriculture and Rural Development from Shashemene, Shala, and Shiraro districts. This study used the data of 346 farmers in the analysis as data from four respondents were dropped later in the analysis. The main objective of this part of the study was to characterize the different potato varieties, both the IVs and the LVs. Characterization of the different potato varieties was carried out as follows.

Firstly, the study identified seven potato varieties, LVs and IVs, and the classification was done by farmers, triangulated with information from agricultural agents. The varieties were: Agazer (AZ), Nech Abeba (NA), Key Dinch (KD), Key Abeba (KA), Gudane (GD), Jalene (JL), and Bule (BL). GD, JL, and BL are IVs that were released by the Ethiopian Institute of Agricultural Research (EIAR) while the others are LVs in which no documentation was

found on how and when these varieties were first introduced in the region. Secondly, to understand important characteristics of the varieties, quality attributes were classified into two dimensions: production- and market-related.

To understand the factors influencing ware potato farmers' decision to grow a particular variety, they were asked the following question (for each of the varieties): 'What was the main reason that led you to grow this variety in the previous season?'

Downstream actors' survey

The main objective of this part of the survey was to understand the quality preferences of buyers in the potato value chain. We carried out this survey in the summer of 2011 among 10 stationed wholesalers, 13 retailers, and 11 big hotels located in Addis Ababa. Because collecting wholesalers largely supply potatoes to the central market, Addis Ababa, we purposely selected the buyers at the central market. The question for buyers was stated as follows: "Please distribute 100 points over the different quality attributes that you may take into account when you are buying ware (consumption) potatoes. Give the highest value to the most important quality attribute, the second highest value to the second most important quality attribute, etc."

2.3.2 Secondary data

The objective of using this data was to understand the extent of quality uncertainty a potato farmer could face when selling potato in the spot market. As a potato trader has to negotiate with a number of sellers in each market day and judge quality on the spot, the likelihood of incorrectly measuring quality might be high; this can have an effect on smallholders' incentive to improve quality.

Thus, to understand the extent of this problem, the study used a database of two years weekly ware potato prices collected between 16 June 2009 and 21 June 2011 from Shashemene local market. Shashemene spot market is the main trade hub of ware potato in Ethiopia (Tesfaye et al., 2008). The data contained information about the price received by farmers and buyers for both a 'high' and 'low' quality delivery. The price data were based on the common commercial (local) variety, NA. Thus, any difference in quality was attributed to tuber size,

physical damages, and other quality criteria in which a specific buyer considers important on the spot. The data were collected on 108 market days by the Office of Shashemene District Agriculture and Rural Development.

2.4 Results and discussion

2.4.1 Characteristics of the sample

Description of potato farmers in the sample

Table 2.1 summarizes the sample characteristics related to potato farmers.

Table 2.1 Characteristics of sampled potato farmers (n=346)

Variables	Total
Male headed households (% yes)	96
Marital status(% yes)	
Unmarried	3.5
Widow	0.3
Married (only one wife)	63
Married (>=2 wives)	33.2
Other demographic characteristics	
Age (years)	36.8
Family size	9.6
Education of the respondent (years in school)	5.7
Highest education in the family (years in school)	8.3
Dependency ratio[a]	1.3
Wealth (as approximated by)	
land (owned) in ha	1.5
Total livestock units TLU[b]	8.1
Access to information	
presence of a mobile phone (% yes)	66.8
presence a radio (% yes)	65
presence a TV (% yes)	9.5
Income from potato sales (2009/2010)	
Mean value (in birr)[c]	9,905
% of potato income from total income	49

[a] measures the ratio between dependents and labor force within the family. [b] Tropical livestock units (TLU=250kg), used as a common unit to describe livestock numbers of various species as a single figure: oxen/cow=1TLU; Calf=0.25TLU; Heifer=0.75TLU; sheep/goat=0.13TLU; young sheep/goat=0.06TLU; donkey=0.7TLU. [c] 1US$ was approximately equals to 12.60 birr.

The average age (year), education (school years), land (ha) and animal holdings in number of livestock units (TLU) were 37, 6, 1.5, and 8, respectively. The average family size was 10, with a dependency ratio of 1.3, implying a higher number of economically inactive members in a household. Over 33% of the respondents had two or more wives. Farmers who practiced polygamy were older (42 years) and less educated (4 school years), and had larger family size (14). In terms of access to information technology, 67% and 65% of the ware potato farmers had a mobile phone and radio, respectively. Potato contributed about 50% of the total household income in the 2009/2010 production cycle.

Description of downstream actors in the sample

Table 2.2 presents the description of buyers at the central market, Addis Ababa. In the 2009/2010 transaction season, mean purchased volume was 957 tons on average for a stationed wholesaler, 42 tons for a retailer, and 7 tons for a hotel. Although stationed wholesalers did not have a direct transaction with potato farmers, they all knew the production region of potatoes; they stated that 65% of the potatoes were purchased from Shashemene area, our study region. However, the hotel managers did not exactly know the production region, as they would normally buy directly from stationed wholesalers with whom they have had contractual relationship in the past.

Table 2.2 Description of potato buyers at the central market place (Addis Ababa)

Mean values	Total (N=34)	Hotels (N=11)	Stationed wholesalers (N=10)	Retailers (N=13)
Amount purchased previous year (in tons)	299.5	6.8	956.8	42.1
Place Purchased (%)				
Addis Ababa (central market)	91.2	72.7	100	100
Addis Ababa (Supermarket)	8.8	27.3	0	0
Knew production region of potato purchased (% yes)	35.3	0	100	15.4
If yes, potato purchased originated from (in %)				
West Arsi Zone (the study area)	65.8	0	65	70
East Arsi zone (South East)	25.3	0	28	26.5
Holeta area (West)	7.2	0	11.7	7
Gojam (North West)	1.7	0	5.3	0

2.4.2 Farmer-based characterization of the IVs and LVs

Characterizing the quality attributes of LVs and IVs using farmers' knowledge can provide better insights into the quality difference among the existing varieties in general and between

the main IVs and LVs in particular. Such analysis can help to understand the underlying problem of quality misalignment in the potato value chain. The specific question addressed in this part is 'How do ware potato farmers characterize currently used varieties (LVs and IVs) in terms of production- and market-related quality attributes?'

Production-related quality attributes

Farmers' assessment of the production-related quality attributes (PRQAs) is reported in Table 2.3. The IVs, with the exception of BL, scored higher than the LVs as to yield. Likewise, the IVs scored the highest in terms of disease tolerance. Regarding drought tolerance, the most common LVs were assessed similar to IVs. However, differences exist concerning maturity period. While GD and JL take on average 123 days to mature, NA, the dominant LV, matures on average in 101 days. As to intensity of crop management, the LVs NA and AZ scored higher than the IVs GD and JL, implying that the LVs take more time for land preparation, planting, weed control, etc. than the IVs. New varieties tend to be more demanding in terms of crop management than local ones, which is not the case in our results. However, this might be because the farmers in the survey only grew the IVs on a small scale; thus they may not recognize the intensity of crop management as they would do for LVs, which were grown relatively at a larger scale.

Table 2.3 PRQAs as evaluated by farmers (mean scores)

Variety	Yield (100kg per Timad)	Maturity period (No. of days)	Tolerance to disease Scale (1-5)	Tolerance to drought Scale (1-5)	Management intensity Scale (1-5)
AZ	26.5 (10.5)	88 (10)	3.7 (1.2)	3.8 (1.1)	3.7 (1.0)
NA	31.2 (11.8)	101 (15)	3.5 (1.2)	3.9 (1.2)	4.3 (0.9)
KD	21.7 (8.3)	70 (11)	2.6 (1.2)	2.8 (1.2)	2.9 (1.1)
KA	21.5 (7.8)	82 (15)	1.8 (0.9)	2.2 (1.1)	3.1 (1.2)
GD[a]	43.8 (18.3)	122 (16)	4.1 (1.0)	3.8 (1.2)	3.7 (1.3)
JL[b]	45.7 (20.1)	123 (18)	4.2 (1.2)	3.7 (1.3)	3.7 (1.3)
BL[c]	24.4 (11.9)	112 (20)	3.8 (1.1)	3.5 (1.4)	2.8 (1.3)

[a, b, c] IVs; standard deviations are given in brackets.

The difference in PRQAs among the varieties was statistically tested using Friedman Test. However, the study only focused on NA and AZ, from the LVs, and GD and JL, from the IVs, as these varieties were the commonly grown ones by ware potato farmers. Among the four varieties, the Friedman Test result suggests (see Appendix 1) the presence of an overall significant differences related to the mean ranks of yield, maturity period, and disease tolerance but no significant differences regarding drought tolerance and crop management

intensity. That is, farmers do not perceive that these varieties vary as to drought tolerance and intensity of crop management, while they differ in yield, maturity period, and disease tolerance.

Market-related quality attributes

Table 2.4 presents farmers' assessment of market-related quality attributes (MRQAs). Scanning through the results, the mean scores for cooking quality and taste appear to be similar; AZ, BL, and JL scored the highest in terms of cooking quality and taste. All the IVs scored the highest in storability while the LV NA scored the highest in stew quality. Nonetheless, although the IVs could be stored for longer periods than the LVs, ware potato farmers generally do not keep potatoes after harvest because of lack of modern storage facilities and the susceptibility of the traditional storage practices for high quality losses. In terms of tuber size, JL and GD, followed by NA, scored the highest. However, there is no major variability regarding color among the four main varieties. Except BL and KD, which are red, the others generally are white/yellowish. Likewise, except AZ and KD, which have an oval shape, the others generally have a round or semi-round shape.

Because the scores for taste and cooking quality were similar, and storability was not considered important, taste and storability were dropped from further analysis. The Friedman Test result also shows (see Appendix 2) that there is an overall significant difference between the mean ranks of tuber size, stew quality, and cooking quality.

Table 2.4 MRQAs as evaluated by farmers (mean scores)

Variety	Tuber size Scale(1-5)	Stew quality Scale (1-5)	Cooking quality Scale (1-5)	Keeping ability(week)	Taste Scale(1-5)	Color
AZ	3.4 (0.7)	3.8 (1.0)	4.6 (0.8)	11.5 (5.5)	4.7 (0.6)	White
NA	3.9 (0.3)	4.8 (0.6)	3.9 (0.9)	8.7 (5.3)	3.9 (0.9)	White
KD	2.3 (0.9)	2.5 (1.1)	3.1 (1.1)	11.1 (5.6)	3.2 (1.1)	Red
KA	2.2 (1.1)	2.6 (1.1)	2.2 (1.0)	8.5 (4.5)	2.0 (1.0)	White
GD	4.4 (0.6)	3.3 (1.0)	3.5 (1.1)	13 (7.6)	3.3 (1.0)	White
JL	4.8 (0.4)	3.4 (1.1)	3.9 (1.1)	11.9 (6.6)	4.0 (0.9)	White
BL	3.0(1.0)	2.2 (1.3)	3.8 (1.4)	15.6 (7.6)	4.2 (1.1)	Red

The results in Appendix 2.1 and 2.2 show an overall significant difference in the mean ranks of PRQAs and MRQAs. As the Friedman Test result does not tell which varieties differ, the study is also interested to understand the quality difference between each of the varieties.

Thus, a post-hoc test is required to determine whether significant differences exist between pairs of the different varieties (Sheldon et al., 1996). Subsequently, a multiple comparison was run using the Wilcoxon Signed-Rank Test. Accordingly, the paired results between 'AZ & NA', 'AZ & JL', and 'NA & GD' are not significantly different regarding disease tolerance, stew quality, and cooking quality, respectively. Furthermore, the two IVs, 'GD & JL', do not significantly differ in terms of yield and maturity period. In all the remaining combinations, the results are highly significant (Table 2.4). The results show that, with the exception of cooking quality related to 'NA & GD', the IVs and LVs are significantly different in terms of the main PRQAs and MRQAs.

In sum, the results of Tables 2.3, 2.4, and 2.5 confirmed that ware potato farmers indeed see quality differences between varieties, particularly between the IVs and the LVs. Subsequently, it would be interesting to know which quality attributes may be more preferred by ware potato farmers/buyers.

Table 2.5 Wilcoxon Signed Ranks Test for MRQAs and PRQAs

	Tuber Size		Stew Quality		Cooking Quality		Yield		Days to Mature		Disease Tolerance	
Variety	Z	Sig.	Z	Sig.	Z	Sig.	Z	Sig.	Z	Sig.	Z	Sig.
AZ & NA	-9.26	.000	-8.81	.000	-9.82	.000	-5.56	.000	-11.48	.000	-.75	.451
AZ & GD[a]	-7.94	.000	-2.66	.008	-4.90	.000	-4.29	.000	-7.46	.000	-4.77	.000
AZ & JL[b]	-11.38	.000	-2.55	.011	-3.93	.000	-5.84	.000	-9.75	.000	-4.41	.000
NA & GD[c]	-6.71	.000	-5.64	.000	-1.05	.293	-4.25	.000	-6.27	.000	-3.40	.001
NA & JL[d]	-11.37	.000	-7.80	.000	-2.85	.004	-6.22	.000	-8.71	.000	-4.35	.000
GD & JL	-4.74	.000	-2.75	.006	-2.93	.003	-.51	.609	-.86	.389	-2.70	.007

[a, b, c, d] comparisons between LVs and RVs.

2.4.3 Factors influencing farmers' production decision and traders' procurement decision

Having described the characteristics of the different varieties, this section addresses the following specific question: 'Which quality attributes do influence farmers' and traders' variety choice?'

Factors influencing farmers' variety choice

As can be observed in Table 2.6, 80% of farmers grew the LV NA. It appears that farmers' who grew NA were largely motivated by the high market demand, which accounted for 57%. This means that farmers' production decision is influenced by the market demand more than the price. This makes sense because price is largely determined by the supply and demand on a specific market day and mostly unpredictable by the time farmers make production decision (to grow a specific variety). The second most grown variety was the LV AZ (48%). The main reason for growing this variety was its high cooking quality.

It is also interesting to note that production-related quality attributes appear to have received low emphasis in farmers' variety choice. Of the farmers who grew NA, only 20% stated that they were motivated by its high yield. Likewise, 14% of farmers who grew AZ claimed early maturity was the main reason in growing this variety. Of the LVs, variety KD, which was grown by 21% of the respondents, appears to have been chosen for its production-related attributes; 73% of them stated that early maturity was the main reason in their decision to grow variety KD. It appears that variety KD is used as a 'hunger breaker' until the main staple crops are ready for consumption, because this crop has a short maturity period compared to the other varieties (Table 2.3).

KA and BL were the least preferred LV and IV, respectively. This confirms the results displayed in Table 2.3 and Table 2.4. Farmers assessed that KA is highly susceptible to disease and has low stew and cooking quality, while variety BL has long maturity period and the lowest stew quality. As expected, the IVs JL and GD were selected because of their yield and disease tolerance characteristics. However, not many farmers grew these varieties in the 2009/2010 production cycle.

Table 2.6 Factors influencing farmers' production decision

Variety	% farmers grew (n=346)	Reasons in growing a specific variety in the 2009/2010 production cycle (in %)						
		High market demand	High price	Good cooking quality	Storability	High Yield	Early maturity	Tolerant to diseases
AZ	48.3	20.4	18	34	7.2	5.4	14.4	0.6
NA	79.5	57.1	17.5	1.7	2.2	20.4	1.1	0
KD	20.5	9.9	2.8	9.9	0	4.2	73.2	0
KA	3.8	46.2	20.4	5.3	7.7	7.7	12.7	0
GD[a]	9	9.7	6.5	12.9	3.2	51.6	0	16.1
JL[b]	19.7	2.9	4.4	1.5	4.4	72.1	0	14.7
BL[c]	1.2	0	0	100	0	0	0	0

[a, b, c] IVs released from research institutes.

In general, the results show that farmers' decision to grow the LVs was mainly motivated by the preferred market-related quality attributes, while their decision to grow the IVs was largely due to the production-related quality attributes (Table 2.6).

Factors influencing buyers' variety choice

Table 2.7 provides an overview of buyers' assigned weights for market-related quality attributes. The study only focused on the preferences of the stationed wholesalers in the central market, Addis Ababa, because 65% of the ware potatoes available in Addis Ababa were supplied by the collecting wholesalers from the study area. Accordingly, stationed wholesalers seemed to have high priority for tuber size, followed by color and keeping ability. Likewise, retailers preferred most tuber color, followed by tuber size. For hotels, color received the highest weight, followed by tuber size and shape. Generally, cooking quality, price, stew quality, and keeping ability were assigned low scores by buyers. With cooking quality, this was expected because potato variety, such as AZ, is often produced for own consumption as cooked (or boiled). However, as to stew quality, the result is surprising because most of the urban households consume potatoes in stew. One possible explanation is that stew quality characteristics might have been captured in tuber size.

Generally, tuber size and color are the most important quality attributes influencing the downstream actors' procurement decision (variety choice).

Table 2.7 Downstream actors' preferences for MRQCs (mean scores from 100 points)

Quality attributes	Total (N=34)	Hotel (N=11)	Stationed wholesaler (N=10)	Retailer (N=13)
Color	37.3	35.4	30.3	44.2
Tuber size	32.8	32.6	38.2	28.8
Keeping ability	7.2	5.0	11.5	5.8
Tuber shape	6.9	15.8	6.0	0
Stew quality	6.2	6.8	6.7	5.4
Price	5.8	2.1	2.0	11.9
Cooking quality	4.1	2.3	5.3	4.6

It was also observed that while the desired color for commercial purpose is white, red color potatoes are used for commercial purpose when wholesalers run out of supply for the white potatoes. With regard to tuber size, 80% of wholesalers, 46% of retailers, 36% of hotel managers preferred large tubers. Generally, large tuber size potatoes are preferred to small (approximately 30mm in diameter), medium, and also to very large tuber size potatoes (approximately more than 57mm in diameter). In terms of color, there is no much difference between the most common LVs and IVs. However, with tuber size, the two main IVs appear to have very large tuber size compared to the LVs (Table 2.8).

Taking these results together, we can better explain why certain varieties are more preferred than others. It appears that the LV NA is popular by both farmers and buyers, particularly compared to the IVs. It has the desirable tuber size, is white in color, and has a round shape. Variety JL and GD, on the other hand, have a tuber size more than what the average buyers require. According to buyers, very large tubers tend to have less quality when used in stew. Furthermore, household consumers in general buy in small quantities; thus, very large tubers create a measurement problem for retailers.

Table 2.8 Some desired quality characteristics by major participants of the potato value chain

Desired characteristics	Hotel (n=11)	Stationed wholesaler (n=10)	Retailer (n=13)
Desired tuber size (mean value)			
very large	27.3	20.0	15.4
large	36.4	80.0	46.2
medium	36.4	0	15.4
small	0	0	23.1

2.4.4 Results on variety development institutes

One of the main problems of the Ethiopian potato value chain is the misalignment of quality produced with quality demanded. For the research institutes, food security is the main criteria in developing new potato variety (Gebremedhin et al., 2008). Researchers have focused on developing varieties that are high yielding, disease tolerant, and adaptable to wider agro-ecological zones. Although these are important quality attributes for potato farmers, varieties with such attributes may not be good in other attributes. The results show that while the IVs have better production-related quality attributes, ware potato farmers have responded to the demands of buyers by growing the preferred LVs, such as NA. That means that seed potato farmers who are specialized and agro-ecologically suited to grow IVs will not have a market for their produce, and the efforts of research institutes to improve the uptake of improved varieties will not be effective. This case represents a misalignment of quality, due to lack of joint decision-making (or incompatibility of objectives), between research institutes and ware potato farmers and buyers.

2.4.5 Seller-buyer relationships and quality misalignment

The relationship between several actors in the potato value chain can influence the alignment of quality, because the incentives to improve quality can differ between these actors. This study has analyzed the relationship between farmers and collecting wholesalers, between collecting wholesalers and stationed wholesalers, and the quality alignment problem in a spot market arrangement. The main question addressed in this section is 'How different coordination mechanisms affect the incentive to improve quality?'

The use of quality signals

There are no quality standards or quality grading to signal quality in the Ethiopian potato value chain. In the absence of third party quality standards, value chain actors use different mechanisms to signal quality. The most common ones are the production region and variety name. These signaling mechanisms are often used to optimize early information exchanges between sellers and buyers who are found at the different stages of the chain. When visiting the wet potato market in Addis Ababa, it was noted that geographical indication (production region) was the most important quality signal in the relationship between collecting

wholesalers and stationed wholesalers. In the relationship between collecting wholesalers and farmers (in a particular region), variety name is a first stage quality signal. Once agreement is reached on the type of variety that collecting wholesalers could buy, the next step is to get specific quality information. In all these cases, transacting parties do not have to meet in person (they can exchange this information by phone or through other means). Not surprisingly, unobservable quality attributes, such as residuals, were not considered important to signal quality (Table 2.9); more likely because of a lack of information and the lack of regulation on this issue.

Table 2.9 Main quality signals between farmers and collecting wholesalers (N=346)

Type of information	% yes
Variety name	94.4
Tuber size	99
Inorganic fertilizer (amount and time of application)	10.9
Pesticides (amount and time of application)	5.6

Quality alignment problem and buyers' response

Even though sellers try to improve the alignment of quality using geographic indication and variety name, such signals cannot reduce buyers' quality uncertainty arising from, for instance, poor crop management, storage condition, and transportation. Buyers reported a number of problems, such as premature tubers, spoilage losses, blackening of tubers, and physical damage. These quality problems were also observed during the study period at the wet potato market in Addis Ababa.

Buyers have responded to these problems by using different mechanisms. For instance, collecting wholesalers have started monitoring the quality of potatoes by visiting specific ware potato farms and by involving in the harvesting and transporting of ware potatoes. For the 2009/2010 production cycle, 56% of the farmers reported that harvesting was carried out by collecting wholesalers using their own (hired) labor force. The dyadic relationship between collecting wholesalers and stationed wholesalers appear to be carried out based on trust, where close personal ties and repetitive interactions play an important role rather than trading anonymously (Table 2.10). As a result, 60% of the stationed wholesalers had their own preferred suppliers (collecting wholesalers). Also, 82% of the hotels and 92% of the retailers in the central market, Addis Ababa, had their own preferred suppliers (stationed

wholesalers). Written contract was only observed in the relationship between big hotels and stationed wholesalers (Table 2.10). Generally, most transactions take place in a non-spot market type of institutional arrangement, which provides higher incentive to transacting parties to improve quality and align quality produced with quality demanded.

Table 2.10 Dyadic relationships between downstream actors

Type of coordination	Total (N=34)	Hotel (N=11)	Stationed wholesalers (N=10)	Retailers (N=13)
Preferred supplier (% yes)	79.4	81.8	60	92.3
Written contract (% yes)	11.1	33.3	0	0

Smallholders' disincentive to improve quality in a spot market type of arrangement

Smallholder farmers also bear high transactional risks when investing in quality, particularly if they deliver potatoes in the nearest spot market. The most common problem is the risk of receiving low price because of quality measurement problem in the spot market. This often happens to smallholder farmers who produce at small-scale level (less than one full truck, approximately 6 to 7 tons of potatoes). Subsequently, small-scale farmers may not directly sell to collecting wholesalers at farmgate. For large-scale farmers (who can meet the minimum delivery condition), the price risk due to quality measurement problem is low because the quality of potatoes is assessed in several occasions such as during pre-harvest, harvesting, and loading. Furthermore, since the delivery is at farmgate and the transaction is likely to be repeated in every production cycle, there will be less chance for an opportunistic behavior to prevail. In contrast, small-scale farmers are often excluded from selling at farmgate because collecting wholesalers may have to incur additional costs to collect potatoes from small farms.

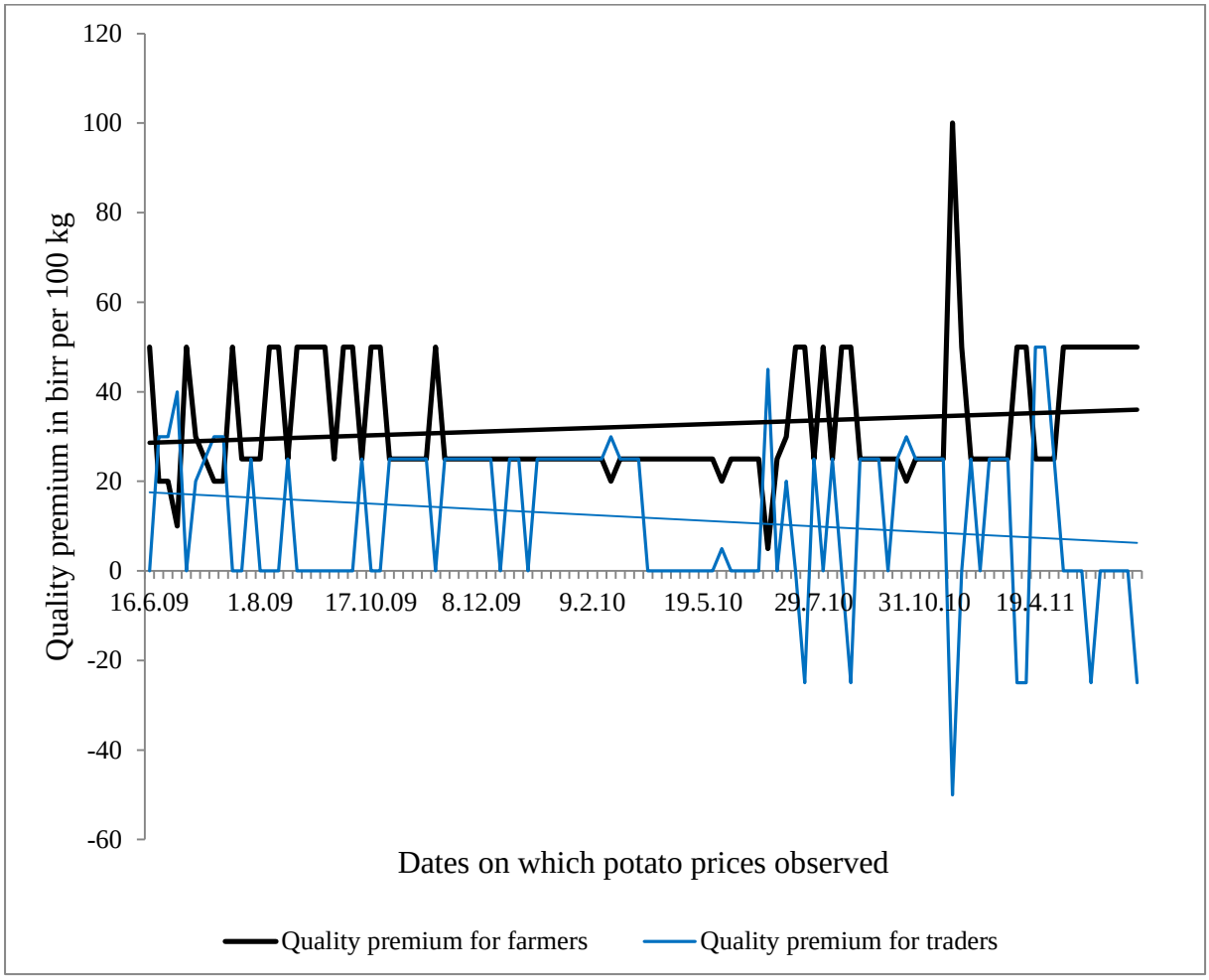
When small-scale farmers sell their potatoes in the nearest market, they are subjected to high price risks due to the presence of a quality measurement problem in this market. This can happen due to one or more of the following causes: (1) traders in the spot market transact with several farmers at a time on a specific market day; they do not take much time to inspect the quality of the whole sack they buy; therefore they tend to pay a price for an average quality (even if the quality of potatoes is higher than the average); (2) farmers deliver potatoes in a sack in which only the top part is visible for inspection by traders; traders often expect that farmers put lower quality potatoes at the bottom of the sack; therefore, they tend

to pay a price that is lower than the true quality of the potatoes would justify; (3) there is large difference between the price for low quality potatoes compared to high quality potatoes; thus, the price risk of incorrect measuring of quality is high; and (4) given the perishability of the product and the high transport cost for farmer bringing potatoes to the market, farmers have few alternatives than to sell at the market day. Thus, the conditions in the spot market make small-scale farmers to be more vulnerable to a quality measurement problem because when a given delivery is incorrectly judged as low quality by traders a significant portion of smallholders' income can be wiped out.

Measuring product quality in a spot market type of arrangement is also an imperfect indicator of a farmer's effort (Hueth et al., 1999) because (1) when deliveries are made in large volumes, measuring the quality of each item in a given delivery would be costly for the trader, and measuring a sample of the delivery would not provide a perfect measure of quality; and (2) certain type of quality may not become apparent until the commodity has traveled further downstream thus may put traders for another quality uncertainty. For instance, due to poor storage conditions, potatoes may develop internal sprouting (Sawyer and Dallyn, 1964) that may physically look good at the time of sale, but this could lead to fast external sprouting and spoilage losses for traders. Consequently, traders buying from the nearest spot market may have to either invest much time to verify quality (which is costly), choose not to monitor quality at all, or use a relatively crude set of grades to measure quality. The findings from this study suggest that traders buying in the spot market use a crude measure of quality, which has a negative effect on the prices farmers receive in this market. Thus, selling potatoes in a spot market arrangement provides lower incentives to improve quality compared to a farmgate type of arrangement.

Indeed, the risk of incorrect measurement of quality may apply to both traders and farmers. However, based on two years weekly price data, the study demonstrated that smallholders' incentive to improve quality is significantly affected by the quality measurement problem in a spot market type of arrangement. The results (Figure 2.1A) showed that a farmer whose delivery is judged as a high quality would get an average quality premium of 32 birr, while a trader who sells a delivery graded as a high quality would only get an average quality premium of 12 birr per 100 kg. Figure 2.1A implies that farmers have the incentive to deliver high quality potatoes, but they are subjected to a high price risk if their delivery (potatoes) is wrongly judged as a low quality delivery. Conversely, traders appear to be relatively

indifferent about quality. The reason is that traders in rural markets can maintain their gross margin more or less similar regardless of how the quality of a given delivery is graded (Figure 2.1B), as indicated by the correlation coefficient, 0.76. Over the two years period, the difference in margin for high quality potatoes and low quality potatoes has narrowed down. Thus, the increasing incompatible of incentives between traders and farmers in a spot market arrangement can lead to quality misalignment in the Ethiopian potato value chain.

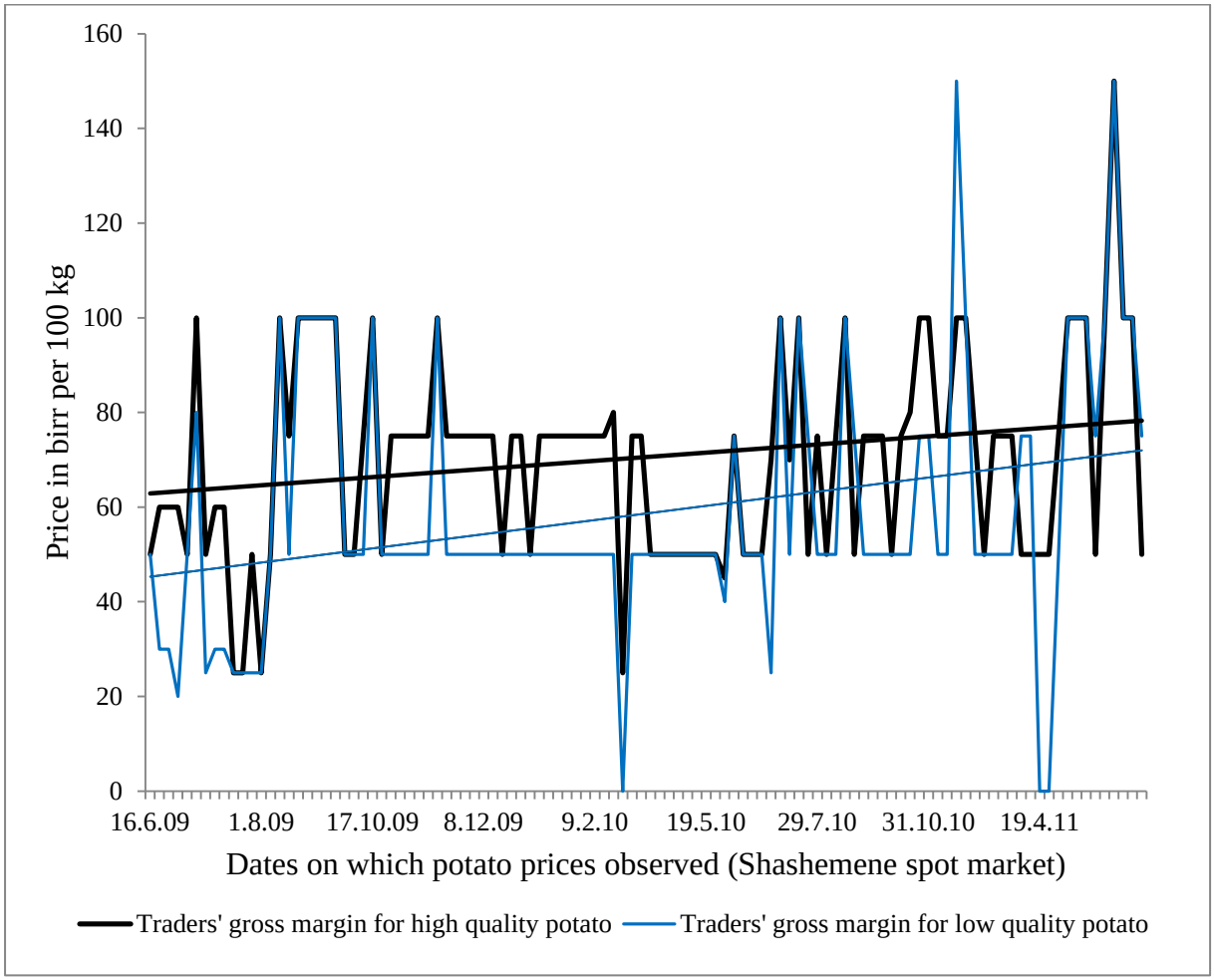


Paired samples correlations = -0.75 (N=108; p<0.01, 95 %); 1US$ =14.5 birr (two years average)

Figure 2.1A Quality premium for traders and farmers in the Shashemene spot market

Furthermore, farmers' price risk from the quality measurement problem seems severe (Figure 2.1A) in that when a farmer's delivery is graded as high quality and thus gets a high premium, traders quality premium would become very low, and vice-versa, (see the correlation coefficient, -0.75). The implication is that this condition would encourage

opportunism to occur. Subsequently, traders will have the incentive to deliberately misrepresent quality, because doing so will improve their quality premium.



Paired samples correlations = 0.76 (N=108; p<0.01, 95 %); 1US$ =14.5 birr (two years average)

Figure 2.1B Traders gross margin for a high and low quality potatoes

In sum, as predicted by transaction cost economics theory, the potato market seems to be moving away from a spot market type of arrangement to improve the alignment of quality produced with quality demanded. There is a much closer dyadic relationship between collecting wholesalers and ware potato farmers, and between collecting wholesalers and other downstream actors. It has become a common practice for wholesalers or their agents to visit specific potato farms. Collecting wholesalers are implicitly regarded as chain coordinators. Indeed, collecting wholesalers are strategically positioned to deal with both ware potato farmers and other downstream actors. At the same time, they have strong trust-based relationship with stationed wholesalers and retailers in the central market, Addis Ababa and in other distant markets.

2.5 Conclusions

The main objective of the present study was to explore the factors that influence quality alignment in the Ethiopian potato value chain. The main research question was: how farmer and trader preferences for specific quality attributes and coordination mechanisms in the farmer-trader relationships affect the alignment of quality in the Ethiopian potato value chain? Because of lack of prior knowledge in relation to the present study, the study has addressed this research question systematically.

First, the existing potato varieties were characterized by ware potato farmers to assess whether these varieties, local and improved, indeed differ in quality. Distinguishing quality into production-related and market-related was important to understand specific quality attributes influencing farmers and buyers' variety choice. Farmers' assessment of the varieties showed that there are significant quality differences among and between the IVs and the LVs, particularly with respect to tuber size, stew quality, yield, maturity period, and disease tolerance.

Second, once each variety was assessed by farmers, it was important to assess which specific quality attributes influence farmers and buyers variety choice. The findings showed that farmers' variety choice is highly influenced by the market demand. Thus, the LVs, such as NA, continue to be grown by farmers. Likewise, buyers' procurement decision is largely influenced by the tuber size and color of potatoes. As a result, a variety with large tuber size is more preferred to small, medium, or very larger tuber size potatoes. In terms of tuber color, white /yellowish potatoes are more preferred than other tuber colors. Based on these findings, the IVs are more preferred for production-related quality attributes while the LVs are more preferred for market-related quality attributes.

Third, the study has analyzed the sources of misalignment for variety choice in the Ethiopian potato value chain – related to variety development and seller-buyer relationships. Regarding variety development, the IVs do not seem to have the desired market-related quality attributes despite these varieties were assessed as high yielding and disease tolerant by farmers. When there is mismatch, ware potato farmers tend to prefer the LVs that they considered are having better market-related quality attributes. This seems the case that 80% the farmers in our

sample continued to grow the dominant LV NA, for at least, in the last five years (2006 to 2010).

Concerning seller-buyer relationships, three factors can affect quality alignment – lack of third party quality standards (certification), buyers' quality uncertainty, and difference in incentive to improve quality in a spot market arrangement (due to problems in measuring quality). Due to the absence of third party quality grading for the final product, value chain actors use production region or variety name to optimize information exchange along the value chain. However, these mechanisms do not provide adequate guarantee against buyers' quality uncertainty. Thus, to respond to these problems, buyers are increasingly involved in the harvesting and post-harvest handling of potatoes. The findings showed that most of the transactions in the study period were carried out at farmgate. This type of arrangement appears to have allowed collecting wholesalers to closely monitor potato quality. Furthermore, selling at farmgate has several advantages for smallholders: (1) they can able to negotiate prices before harvest, and thus can minimize the opportunistic behavior of traders in the spot market; (2) they do not have to search for transportation as this will be arranged by traders; and (3) it provides smallholders the incentive to improve quality.

In sum, the present study has provided further insights into the factors influencing variety choice and thus the alignment of quality in the Ethiopian potato value chain. Varity choice, from the perspective of ware potato growers, is a multi-faceted decision problem influenced by the lack of joint decision-making or information exchange when developing new varieties, lack of third party quality grading, and lack of proper incentives for quality improvement. Furthermore, although spot market arrangements have been extensively studied, particularly from the perspective of transaction cost economics, little research has been done in comparing the effect of farmers' decision to sell in the spot market and at farmgate. Compared to selling in the spot market, selling at farmgate has often been considered less remunerative (Fafchamps and Hill, 2005). One question, which seems overlooked, is the problem of measuring quality that smallholders encounter when they decide to sell in the spot market. This study has provided further insights into the importance of a farmgate type of arrangement in enhancing smallholders' incentive to improve potato quality and market access, because farmers' effort is better rewarded in this type of arrangement than that of the spot market. Indeed, the transaction cost economics theory has recognized the problem of the spot market arrangement regarding the difficulty of measuring quality. However, such

analysis has been largely done from the buyers' perspective, assuming that buyers are the ones to be mostly affected because of the difficulty of measuring the performance of the seller (Hueth et al., 1999).This study complements to the findings of Muto and Yamano (2009) by showing the importance of a farmgate type of arrangement for smallholders' selling perishable and bulky products such as potatoes.

The findings of this study also provide two policy implications. First, the potato crop has increasingly become a source of cash income for farmers in the study area; it contributed about 50% of total income in 2009/2010 production cycle. However, too much focus of the research institutes on production-related quality attributes has resulted in a low uptake of IVs. Thus, research priorities need to be aligned with the quality requirements of buyers to enhance the uptake of IVs by (ware) potato farmers. This would offer a better market for the seed growers in the highlands by aligning their seed potato production with the demands of ware potato growers in the Rift valley region, which controls at least 65% of the ware potato supply in the capital, Addis Ababa. Second, even though selling at farmgate provides better incentive for ware potato farmers, small-scale farmers who cannot fulfill the minimum delivery condition appear to be excluded from the main potato value chain. Thus, establishing village collection centers may encourage collecting wholesalers to buy from these farmers at farmgate.

Appendix 2.1 Mean ranks of production-related quality attributes (Friedman Test)

Variety	Yield	Disease tolerance	Drought tolerance	Maturity	Management practices
AZ	1.73	1.8	2.29	1.19	2.27
NA	1.83	2.29	2.58	2.13	2.62
GD	3.25	2.77	2.61	3.31	2.56
JL	3.19	3.13	2.53	3.37	2.55
N	24	63	56	67	56
χ^2	34.5	43.6	2.6	157.6	3
df	3	3	3	3	3
Sig	0.00	0.00	0.464	0.00	0.391

Appendix 2.2 Mean ranks of market-related quality attributes (Friedman Test)

Variety	Tuber size	Stew quality	Cooking quality	Keeping ability	Taste
AZ	1.37	2.41	3.18	2.6	3.44
NA	2.08	3.49	2.26	1.82	2.14
GD	2.96	1.9	2.02	2.71	2.01
JL	3.58	2.2	2.54	2.88	2.41
N	98	58	71	41	75
χ^2	200.7	61.4	38.7	19.6	69.6
df	3	3	3	3	3
Sig	0.00	0.00	0.00	0.00	0.00

Chapter 3

Adoption of improved potato varieties in Ethiopia: the role of agricultural knowledge and innovation system and smallholder farmers' quality assessment

This chapter is based on the article submitted to Agricultural Systems as 'Abebe, G.K., Bijman, J., Pascucci, S., and Omta, O. Adoption of improved potato varieties in Ethiopia: the role of agricultural knowledge and innovation system and smallholder farmers' quality assessment.

3. Adoption of improved potato varieties in Ethiopia: the role of agricultural knowledge and innovation system and smallholder farmers' quality assessment

3.1 Introduction

In addressing concerns about the availability of sufficient food in a growing population scenario, genetically improved varieties of staple crops play an important role (Rizvi et al., 2012; Serageldin, 1999). Potato is considered as one of the main staple crops to ensure food security (Knapp, 2008). Potato provides more calories, vitamins, and nutrients per area of land than any other staple crop (Sen et al., 2010). Improved potato varieties (IVs) have better yield (Chakraborty et al., 2000) and enhanced resistance to late blight (Song et al., 2003) and virus and bacterial wilt (Thiele, 1999). Potato can play a significant role in securing food at the household level, but also in generating income for smallholders, thereby contributing to the economic sustainability of agricultural systems in developing countries (Thompson and Scoones, 2009). In Ethiopia, potato has increasingly become a source of cash income for farmers, next to its importance for household consumption (Gildemacher et al., 2009; Mulatu et al., 2005).

Although Ethiopian farmers may have an incentive to grow IVs because of enhanced production-related quality attributes such as yield and disease resistance, they often are reluctant to do so. To illustrate, in an effort to improve the performance of the potato sector, the Ethiopian Institute of Agricultural Research (EIAR), with supports from the International Potato Center (CIP), distributed 18 IVs in the last two decades (Gebremedhin et al., 2008). However, the rate of adoption of IVs by ware potato farmers (farmers that grow potato for consumption rather than to be used as seed) has been very low. Data from a national representative survey (collected from over 8000 households) revealed that the use of improved seed potato was about 0.5% (ESCS, 2005).

Although the problem of low adoption, by ware potato farmers, is acknowledged by the EIAR, the potential causes have not been fully investigated. For instance, the EIAR mentions shortage of improved seeds and poor supply systems as the main limiting factors

(Gebremedhin et al., 2008). In other words, adoption is assumed to be low because not all potential adopters have access to improved varieties. However, this claim is not supported by empirical evidence. Abebe et al. (2010) found that IVs that were released in recent years were widely grown by seed potato farmers in the highlands. However, government agents and NGOs remained the main buyers of the IVs. This study conjectures that the problem of low adoption of IVs cannot be solely explained by the unavailability of quality certified seed or the lack of a formal seed supply system. In this chapter the following research questions is addressed:

RQ2: *How do the agricultural knowledge and innovation system and farmer' perception of local varieties affect the adoption of improved potato varieties?*

The development of IVs by the Ethiopian agricultural knowledge and innovation system (AKIS) seems to result in new varieties that lack appropriate attributes. Consequently, farmers may prefer local varieties (LVs) if they assess the characteristics of the LVs as superior compared to the characteristics of the IVs. The development of varieties that do not meet farmer preferences has been attributed to the linear character of AKIS (Thompson and Scoones, 2009). In response, a participatory research and development system has been proposed, which puts farmers at the center of the innovation process (Bishaw and Turner, 2008). In a participatory approach, local knowledge is given a high value, allowing farmers to work with researchers to design new technologies and to adapt existing ones to local circumstances (Ceccarelli and Grando, 2007; Sperling et al., 2001). Even when IVs have superior quality attributes compared to LVs, low information exchange between research and extension and farmers can also lead to low adoption (Koundouri et al., 2006; Rizvi et al., 2012; Saha et al.,1994). An effective extension system aims to build the capacity of farmers by exposing them to information that can reduce uncertainty about expected outcomes of a new technology (Feder et al., 1985). When research, extension, and agricultural education operate as stand-alone institutions, farmers may be reluctant to adopt because they have difficulties in understanding and appreciating the characteristics of new varieties (Rivera et al., 2005). That is, uncertainty about expected outcomes of IVs may induce farmers to continue growing LVs, of which they have good knowledge of strengths and weaknesses both in production and marketing.

Weak receptiveness to technological change and innovation has been explained by specific farmer characteristics, such as risk-averseness (Abadi Ghadim et al., 2005; Feder et al., 1985; Feder and Umali, 1993; Just and Zilberman, 1983), wealth or household income (Sall et al., 2000), or socio-cultural resistance (Drechsel et al., 2005; Moser and Barrett, 2003). However, implicit in these studies is that the technology to be adopted is suitable (Adesina and Baidu-Forson, 1995) and concerns a single-attribute type of technology, such as a new harvesting machine or irrigation equipment, for which efficiency is the key evaluation criterion. However, for a multi-attribute technology, such as new crop varieties, it is much more difficult to evaluate the advantages and disadvantages. Lancaster (1966) noted that a product possesses multiple attributes, and that utility is provided by individual attributes. New potato variety is an example of a multi-attribute technology delivering utility in such diverse attributes like disease resistance, yield, cooking quality, stew quality, tuber size, and tuber shape. Thus, the decision to adopt IVs is not only determined by the farmer's risk attitude but also by the farmer's preference for several product attributes. Even though IVs may be superior in particular production-related attributes, farmers may prefer to continue growing LVs because of their preferred market-related attributes.

The present study makes several contributions to the literature on adoption of improved crop varieties.

First, the study focuses on ware potato farmers producing for the market, not on seed potato growers or farmers growing for own consumption. Problems related to seed potato supply systems have relatively received high attention in recent studies (e.g., Gildemacher et al., 2009a; Gildemacher et al., 2009b; Gildemacher et al., 2011; Hirpa et al., 2012; Hirpa et al., 2010) and by the International Potato Center (CIP). For instance, in East Africa, CIP has involved farmers in Integrated Pest Management (IPM) experiments and variety selection of sweet potatoes (Abidin, 2004; Smit and Odongo, 1997; Thiele et al., 2001). In Ethiopia, CIP used participatory research approaches such as farmer fields schools (FFSs) and farmer research groups (FRGs) among seed potato growers in the highland areas (Ortiz et al., 2011). However, the link between seed potato growers and ware potato farmers has not received much attention.

Second, this study applies a system perspective to understand the factors that determine adoption, including both AKIS and value chain actors. Recently, Ortiz et al. (2013) studied potato innovation systems in Bolivia, Ethiopia, Peru and Uganda, focusing on the roles of different institutions involved in the potato innovation system. They found that interactions among stakeholders can improve the working of the potato innovation system. However, while their study focused on analyzing the processes of innovation, this study analyzes the performance of the Ethiopian AKIS based on adoption rates. This study complements to the findings of Ortiz et al. (2013) and provides further evidence on the determinants of adoption of IVs in Ethiopia. While research, extension, cooperatives, and NGOs could all play an important role in the development and diffusion of new varieties (Ortiz et al., 2013), buyers preferences are crucial in farmers' decisions to choose particular varieties (Asfaw et al., 2012). However, the influence of buyers on variety choice is often not taken into account in adoption studies.

Third, there has been little attention for the impact of farmers' assessment of existing varieties on the probability of adopting new ones. This study analyzes the relationship between farmers' assessment of production and market-related attributes of LVs and the probability of adopting IVs. This has not been explored before. For instance, Sall et al. (2000) and Adesina and Baidu-Forson (1995) studied the effect, on adoption, of farmers' perception about the characteristics of new technologies but did not include the existing ones. This study investigates the likelihood of adoption of IVs by looking at farmer preferences for particular attributes of LVs.

Fourth, although potato is an increasingly important food crop in developing countries, it has received little attention in the adoption literature, particularly compared to other staple crops like rice, maize, and sorghum. As there are important differences between potato and cereal crops (Ortiz et al., 2013), the findings from traditional adoption literature may not be sufficient to understand farmers' decisions to grow improved potato varieties.

The aim of this paper is to provide insights into the determinants of adoption for IVs by analyzing farmers' assessment of (a) the operation of the Ethiopian AKIS and (b) the attributes of LVs. Regarding AKIS, the study is particularly interested in how farmers experience and assess technical assistance by extension services, research institutes, NGOs,

and cooperatives. In addition, the study seeks to know the impact of farmers' use of their main buyer(s) as a source of advice.

Adoption decisions have been analyzed using static or dynamic models. Static models only explain adoption decisions at a particular point in time. Dynamic models are considered ideal to study adoption decisions over several periods (Koundouri et al., 2006). However, it requires panel data, which is difficult to obtain. To partly solve this limitation, this study, following Besley and Case (1993), uses a model that measures the persistence of adoption over five years (however, this does not necessary reflect the rate of seed renewal in Ethiopia). Furthermore, studies have shown that cross-sectional data can be safely used to analyze adoption decisions when the adoption process moves toward its completion (Besley and Case, 1993; Cameron, 1999). This study benefits from the fact that the IVs were released at least five years before conducting this research. Nevertheless, the study pays due attention with the interpretation of the results, as the parameter estimates do not necessarily reflect causal relationships due to possible omitted variables bias and/or reverse causality (Cameron, 1999; van Rijn et al., 2012).

The remaining sections of the chapter are as follows. Section 3.2 explains the conceptual model. Section 3.3 presents the data and methods, followed by the results and discussion in section 3.4. Section 3.5 provides the conclusions.

3.2 Conceptual model: factors influencing adoption

3.2.1 The impact of AKIS on the adoption of IVs

According to Rivera et al. (2005), AKIS encompasses the entire system of agencies and institutions that provide rural people with the knowledge and information necessary for innovation in their diversified livelihoods. The AKIS literature distinguishes two models for the development and diffusion of new technologies – the linear model and systemic model. The linear model assumes farmers as passive recipients of new technologies. Hence, innovations are seen to arise from international research centers then passed down to national research centers, extension agencies, and finally to farmers (Biggs, 1990; Rogers, 1995). Publicly-sponsored AKIS often generates generic technologies that do not align with farmers'

needs. Therefore, AKIS organized along the lines of the linear model has little influence on farmers' decisions (Pascucci and de-Magistris, 2011). In contrast, the systemic view on AKIS acknowledges that the agricultural research and technology system contains diverse objectives expressed by different actors (Rivera et al., 2005), assumes the non-linear and context specific nature of innovation processes, and guides interactions among different stakeholders (Klerkx and Leeuwis, 2008; Sumberg, 2005). The systemic model emphasizes decentralized decision-making, participation of private actors, institutional pluralism, demand-driven research and extension (Pascucci and de-Magistris, 2011; Rivera, 2008; Rivera et al., 2005). While the linear model of AKIS assumes that farmers are mere recipients of agricultural innovations, the systemic view considers them as part of the innovation process, even as originators of agricultural technologies (Rivera et al., 2005). The systemic model is assumed to lead to higher adoption rates.

In Ethiopia, AKIS consists of three main components – the Ethiopian Institute of Agricultural Research (EIAR), the Regional Agricultural Research Institutes (RARIs), and Higher Learning Institutes (HLIs). While the EIAR is responsible for the supply of improved agricultural technologies, coordination of agricultural research, and capacity building of researchers at the national level, the RARIs and HLIs are in charge of research and education at regional level. There are about 55 research centers and sites across different agro-ecological zones of Ethiopia. Although over 2% of GDP is being spent on agricultural extension every year (Spielman et al., 2010), technology adoption has been slow, crop yields have remained low, and no sustained breakthroughs were seen in regions where research had been carried out (Abate et al., 2011).

Several factors have been identified as potential causes for the ineffectiveness of the Ethiopian AKIS. First, policies pertaining to research priorities have largely been driven by food security issues (Spielman et al., 2011). Hence, production-related attributes, such as yield, have been given high priority in developing new varieties (Gebremedhin et al., 2008). However, high yielding varieties may not have high market demand. Second, the Ethiopian AKIS is characterized by a lack of coordination among the formal institutes engaged in R&D activities, as well as weak linkages between these institutes and farmers and private sector firms (Spielman et al., 2011). Third, the extension service in Ethiopia often pays little attention to farmers' experiences and knowledge, while extension workers even lack up-to-date knowledge and skills (Belay and Abebaw, 2004).

The conceptual model for this study includes several variables like frequency of use of technical assistance from extension services, from research institutes, from cooperatives, or from NGOs; advice from the main buyer(s); and time spent in a farmer training center (FTC). FTCs provide education (certificate and non-certificate training), market information, advisory services (such as land and natural resource management), and promotes the use of improved technologies (Tefera et al., 2011). FTCs have been introduced in 2009 by the Ethiopian government as part of its agricultural-led development strategy. If the innovation development and diffusion system works effectively, a positive relationship is expected between farmer assessment of the AKIS characteristics and the probability of adoption (Rivera et al., 2005). The variable 'main buyer as a source of advice' is used as a proxy in assessing whether downstream actors in the potato value chain are part of the Ethiopian AKIS, as proposed by the systemic model on innovation. To control farmer capital constraints, the study includes access to credit in the models.

3.2.2 The impact of farmers' quality assessment of LVs on the adoption of IVs

Quality is an elusive concept (Luning et al., 2002); it is difficult to measure as it depends on many factors such as the nature of the product, the user of the product, and the market situation (Sloof et al., 1996). Defining quality from a supply chain perspective is even more problematic as different chain actors may assess quality differently based on which attributes of the product they find more or less important (Table 3.1).

Table 3.1 Interpretation of quality by various chain actors

Actor	Quality aspects
Breeder	vitality of seed, yield
Grower	yield, uniformity, disease resistance
Distributor	shelf life, availability, sensitivity to damage
Retailer	shelf life, diversity, exterior, little waste
Consumer	taste, healthiness, perishability, convenience, constant quality

Source (Ruben *et al*., 2007 p. 30)

Because farmers assess varieties both on their agronomic characteristics and on their marketability, the study distinguishes quality between production-related and market-related attributes. Quality attributes such as yield, disease tolerance, maturity period, drought

resistance, and intensity of crop management are production-related, because they determine the attractiveness of a particular variety from a farming perspective. Quality attributes like tuber size, stew quality, cooking quality, and shape are market-related, as these attributes determine the attractiveness of a variety from the customer point of view[6]. If ware potato farmers have a positive assessment about important production- and market-related quality attributes of the LVs, the probability of adopting IVs is low, ceteris paribus.

It is also expected that household/farm characteristics influence the adoption of IVs; these variables are commonly included in adoption studies (Abdulai and Huffman, 2005; Floyd et al., 2003; Mariano et al., 2012; Schipmann and Qaim, 2010; Thangata and Alavalapati, 2003).

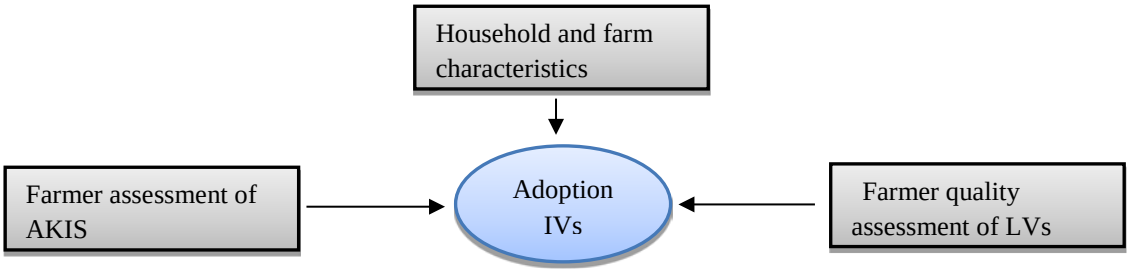


Figure 3.1 Conceptual model

Fig. 3.1 shows the conceptual model. This study hypothesizes that a farmer's adoption decision is conditioned by farmers' assessment of the role of AKIS and the quality of LVs and by household and farm characteristics.

3.3 Data and Methods

3.3.1 Data

Data have been collected in the context of the Ethiopian potato value chain, with a particular emphasis on the Rift Valley region. Although potato can be produced in most parts of the

[6] Stew quality refers to the taste of ware potatoes when they are boiled in a mix (i.e., a stew), such as with vegetables. On the other hand, cooking quality refers to the taste of the potato when consumed boiled without mixing with vegetables.

country, this study focuses on this region for three main reasons. First, the unit of analysis is the farmer producing ware potatoes. Ware potato farmers in the Upper Rift Valley region are the main suppliers of ware potatoes to the major cities of Ethiopia. For instance, the Shashemene spot market, in the center of the study region, is the main trade hub of ware potatoes in Ethiopia (Emana and Nigussie, 2011; Tefera et al., 2011). Second, this study aims to analyze how farmers' perception regarding the quality of LVs influences the adoption of IVs. Thus, it is necessary that the farmers in the survey have the same understanding of the LVs. In Ethiopia, variety names lack standardization and are often attached to local languages (Cavatassi et al., 2011). Focusing on one region does help to avoid problems arising from confusion of variety names. Third, there are several studies (related to seed potato supply systems) carried out in the highland areas of Ethiopia (Abebe et al., 2013; Gildemacher et al., 2009a; Gildemacher et al., 2009b; Gildemacher et al., 2011; Hirpa et al., 2012; Hirpa et al., 2010; Mulatu et al., 2005).

Data were collected from 346 potato farmers, randomly selected from the land ownership register obtained from the Office of Agriculture and Rural Development. The survey was administered in person by five trained persons. Supervision and quality checks were made by the principal investigator. Table 3.2 reports description of the main variables.

Panel A presents summary statistics for the adoption data. The first adoption variable refers to the presence of at least one IV on the farm. Thus, the presence of IVs is recorded if the farmer had grown at least one IV during 2006 to 2010. Accordingly, on average 27% of farmers in the sample had adopted at least one IV during this period. Since this might reasonably be a shallow measure of adoption, a second variable, persistence of adoption, is introduced; it refers to the number of years a farmer has grown IVs on his farm[7]. Finally, Panel A also introduces variables related to the intensity of adoption. Firstly, the study uses the percentage of farm land cultivated with IVs in the production year 2010. In addition, a percentage of total area for growing potatoes is used to calculate the intensity of adopting the IVs. Accordingly, an adopter allocated on average 8% of the total agricultural land or 20% of the land dedicated for potato production to grow the IVs.

[7] If a farmer would switch from one IV to another, this is recorded in the persistence of adoption model but not in the presence of adoption model.

Table 3.2 Descriptive statistics

Variable	Type	Obs	Mean	Std. Dev.	Min	Max
Panel A: Adoption variables						
Presence of adoption	Dummy	346	0.28	0.45	0	1
Years of adoption	Continuous	346	0.48	0.86	0	5
Percentage of land with IVs on total farm land	Percentage	344	2.1	6.3	0	6.3
Percentage of land with IVs on potato farm land	Percentage	345	5.1	14.2	0	100
Panel B: Role of AKIS						
Frequency of use of technical assistance from extension agents	Scale; 1=never 4 =very often	346	2.82	0.92	1	4
Frequency of use of technical assistance from research institutes	Scale; 1=never 4 =very often	346	2.41	0.70	1	4
Frequency of use of technical assistance from coops/associations	Scale; 1=never 4 =very often	346	2.315	0.54	1	4
Frequency of use of technical assistance from NGOs	Scale; 1=never 4 =very often	346	2.214	0.48	1	4
Days spent in farmer training centers	Continuous(in days)	346	6	11	0	90
Main buyer as a source of advice	Dummy	346	2.15	0.56	1	4
Access to credit	Dummy	346	0.09	0.28	0	1
Panel C: Quality assessment of LVs						
Yield	Continuous ((100Kg/0.25ha))	337	27.82	10.76	5	90
Disease resistance	Scale; 1=very low 5 =very high	346	3.15	0.82	1	5
Drought resistance	Scale; 1=very low 5 =very high	346	3.50	0.87	1	5
Intensity of crop management	Scale; 1=very low 5 =very high	346	3.90	0.75	1	5
Maturity period	Continuous (in days)	344	89	11	60	140
Tuber size	Scale; 1=very small 5 =very large	346	3.23	0.57	2	5
Tuber shape	Categorical (1 = full round; 2=semi-oval; 3=oval)	346	1.92	0.32	1	3
Stew quality	Scale; 1=very low 5 =very high	346	3.87	0.71	1	5
Panel D: Household and farm controls						
Age of the respondent	Continuous(in years)	346	36.80	10.55	20	75
Farmer being a male	Dummy (1= male)	346	0.96	0.20	0	1
Farmer years of education	Continuous(in years)	346	5.65	3.54	0	15
Family size	Continuous(in members)	346	9.59	5.17	1	39
Presence of a motorbike, car and/or a truck	Dummy (1= presence)	346	0.03	0.19	0	2
Presence of a mobile phone	Dummy (1= presence)	346	0.67	0.47	0	1
Presence of a radio	Dummy (1= presence)	346	0.65	0.48	0	1
Presence of a television	Dummy (1= presence)	346	0.10	0.29	0	1
Percentage own land (of total land used)	Percentage	344	73.1	25.6	0	100
Number of livestock units	Continuous (in TLU)[a]	346	9.0	17.9	0	274

[a] Tropical Livestock Unit (TLU) is used as a common unit to describe livestock numbers of various species as a single figure that expresses the total amount of livestock present. Accordingly oxen/cow=1TLU; calf=0.25TLU; heifer=0.75TLU; sheep/goat=0.13TLU; young sheep/goat=0.06TLU; donkey=0.7TLU.

Panel B summarizes the variables related to the role of AKIS, which are defined as follows. The variables 'Frequency of use of technical assistance from extension services', 'Frequency of use of technical assistance from research institutes' 'Frequency of use of technical assistance from cooperatives', 'Frequency of use of technical assistance from NGOs', and

'Main buyer as a source of advice' are measured by the perceived frequency of technical assistance or advice received by the ware potato farmers over the last two years in a four point scale; 1 implies that the respondent had not received any technical assistance or advice and 4 implies that the respondent had received technical assistance or advice more often in the last two years (at least once every three months). This technical assistance is not related to potato production per se, but it refers to general farm management practices. The variable 'Number of days spent in farmer training centers' is measured by the number of times (days) the respondent had attended trainings organized in farmer training centers in the last year. Also, the variable 'Access to credit' is measured as a dummy variable; 1 implies that the respondent had received credit at least once in the last two years, and 0 implies otherwise. All the variables refer to the year 2010.

Technical assistance variables could potentially be endogenous, particularly due to possible reverse causality or simultaneity, meaning the adoption of IVs could increase the frequency of use of technical assistance. However, in the case of this study, usage of technical services is indeed exogenous for at least two reasons. Firstly, technical assistance refers to general and not specialized services. In other words, farmers are exposed to different technical services dealing with the farm management in general and not related to specific crops or adopted technology. Secondly, technical assistance or extension services are given in a 'top-down' fashion, and each farmer has equal chance of receiving technical assistance. This means that farmers cannot access to services 'on demand'. Thus, by design, a farmer who has adopted an IV is not likely to receive a different treatment to use technical assistance more often than a farmer who did not adopt an IV.

Panel C reports variables related to quality assessment for the LVs. Firstly, the study had to identify the main potato varieties in the study area. The identification was based on variety names and was made by the surveyed farmers, triangulated with information obtained from agricultural agents and focus group discussions. Subsequently, the study documented four LVs (Agazer (AZ), Nechi Abeba (NA), Key Dinch (KD), and Key Abeba (KA)), and three IVs (Gudane (GD), Jalene (JL), and Bule (BL)). Secondly, because different supply chain actors define quality differently, the study systematically analyzes quality using two categories of quality attributes: production-related and market-related. Attributes like yield, disease tolerance, maturity period, drought resistance, and management intensity are

production-related because they determine production practices. On the other hand, tuber size, stew quality, and shape are market-related attributes because they determine sales options.

Because the objective is to analyze the impact of farmers' attachment toward the quality attributes of LVs on the adoption of IVs, the quality assessment variables relate only to the LVs. Variables 'Disease resistance', 'Drought resistance', 'Intensity of crop management', 'Maturity period', and 'Yield' are used to define the production-related quality attributes of LVs. Except variables 'Maturity period' (measured in days) and 'Yield' (measured in quantity produced per unit (100 kg/ 0.25ha) in the last year), the remaining variables are measured using a five-point scale; 1 implies that the LV has a very low desirable quality attribute, and 5 implies the LV has very high desirable quality attribute. Similarly, variables 'Tuber size', 'Stew quality', and 'Tuber shape' are used to define the market-related quality attributes of LVs. 'Tuber size' is measured in a five-point scale; 1 implies that the LV has very small tuber size (approximately less than 30mm in diameter), and 5 implies that the LV has very large tuber size (approximately larger than 57mm in diameter). Stew quality is measured in a five-point scale; 1 implies that the LV has very low stew quality, and 5 implies that the LV has a very high stew quality. Variable 'Tuber shape' is measured using a three-point scale; 1 implies that the LV is fully round shape, and 3 implies the LV is fully oval shape.

Finally, Panel D presents household and farm related variables, which include age; gender; farmer education; family size; number of livestock units; land ownership; presence of a motorbike, car, and/or truck; presence of a mobile phone; presence of a radio; and presence of a television.

Fig. 3.2 presents an overview of the persistence of adoption for IVs. 73% of ware potato farmers did not adopt any of the IVs during 2006 to 2010. Most of the adopters tried the IVs only once.

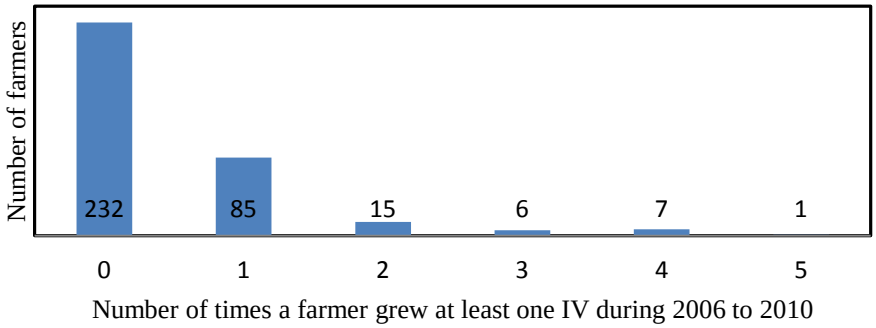


Figure 3.2 Persistence of adoption for the IVs

Tables 3.3 to 3.5 summarize the results of the different models. Estimations were computed using Stata 12.0 software, and are reported with robust standard errors for a potential problem of heteroscedaticity.

3.3.2 Empirical model

Having described the variables and the data, it is important to analyze the determinants of ware potato farmers' decision to adopt, and if yes with what intensity these farmers adopt the IVs. In the empirical model, this study considers the correlation between different measures of adoption and variables related to the role of AKIS and farmers' quality assessment.

$$T_i = \alpha + \beta_1 A_i + \beta_2 Q_i + \delta C_i + \varepsilon_i,$$

where T_i refers to technology adoption variables for farmer i, where i=1, …, 346. Technology adoption variables include presence of IVs, total number of years IVs have been used, percentage of total farm land cultivated with IVs in 2010, and percentage of land dedicated to potato cultivated with IVs in 2010. A_i refers AKIS variables; Q_i refers to quality assessment variables for LVs; and C_i is a vector of control variables.

Probit or logit models have often been proposed to analyze the presence of adoption (Abadi Ghadim et al., 2005; Moser and Barrett, 2006). The Probit model takes a value of 1 for the presence of adoption and 0 otherwise. A lack of panel data has always been a problem in adoption studies although some studies, such as Cameron (1999) and Conley and Christopher

(2001) managed to use panel data. Partly solving this limitation is the use of recall data on each farmer's adoption history (Besley and Case, 1993; Moser and Barrett, 2006). Hence, in the persistence of adoption models, the study analyzes the determinants of adoption using a recall technique. The Ordered Probit model takes a value of 0, 1, 2, 3, 4, or 5, depending on the number of years a farmer had grown any of the IVs during 2006 to 2010. To measure the intensity of adoption, the treatment effect model is used. The treatment effect model, also called Heckman sample selection or Heckman correction model, is a statistical method used to correct selection biases (e.g., to correct biases from non-randomly selected samples).

3.4 Results and discussion

3.4.1 Results

Presence of adoption

Table 3.3 shows that frequency of use of technical assistance from NGOs, use of main buyer as a source of advice, and access to credit are significant. With regard to quality assessment variables, crop management intensity, drought resistance, and stew quality are significant. Also, it is important to note the interpretation of quality assessment variables; they refer to farmers' perception of the quality of LVs. Thus, a negative coefficient for any of these variables means ware potato farmers value more the quality attributes of LVs, which implies a low probability of adopting the IVs. Farmer years of education, presence of a television or radio, number of livestock units, family size, farmer being a male significantly affect the probability of adoption. The presence of a radio or television may also indicate the level of wealth. Thus, wealthier farmers are more likely to adopt as they can afford to buy IVs.

Frequency of use of technical assistance from NGOs is also expected to be significantly related, as some NGOs were actively involved to promote the IVs in the region. Controlling other variables at mean values, the results show that frequency of use of technical assistance from NGOs and access to credit are positively correlated to the likelihood of adoption. Perhaps, one interesting result is the relationship between use of main buyer as a source of advice and the probability of adoption. Farmers who use main buyer as a source of advice have a low chance of adopting the IVs. Furthermore, frequency of use of technical assistance

from extension services, research institutes, and farmer cooperatives do not have a significant relationship with farmers' adoption decision.

Table 3.3 Parametric estimation of the presence of adoption for growing at least one IV between 2006 and 2010

	Probit model		
Variables	Coef.	Robust Std. Er.	
Frequency of use of technical assistance from extension agents	-0.004	0.110	
Frequency of use of technical assistance from research institutes	0.064	0.117	
Frequency of use of technical assistance from coops/associations	0.001	0.169	
Frequency of use of technical assistance from NGOs	0.568	0.272	**
Days spent in FTC	0.013	0.008	
Main buyer as a source of advice	-0.563	0.170	***
Access to credit	0.842	0.257	***
Productivity/yield	-0.012	0.009	
Disease resistance	0.012	0.142	
Drought resistance	-0.213	0.126	*
Intensity of crop management	-0.369	0.126	***
Maturity period	0.005	0.009	
Tuber size	-0.098	0.181	
Tuber shape – full round	-0.467	0.489	
Stew quality	-0.250	0.137	*
Age	0.011	0.010	
Farmer being a male	0.736	0.442	*
Farmers years of education	0.079	0.029	***
Family size	0.039	0.023	*
Presence of a motorbike, car and/or a truck	-0.429	0.567	
Presence of a mobile phone	0.109	0.225	
Presence of a radio	0.481	0.206	**
Presence of a television	0.748	0.292	***
Percentage of own land	-0.002	0.004	
Number of livestock units (TLU)	-0.032	0.016	**
Constant	0.211	1.317	
N	334		
R2	0.281		

* $p < 0.1$; ** $p < 0.05$; $p < 0.01$.

The results show that crop management intensity is highly and negatively correlated to the probability of adoption; i.e., farmers perceive that LVs require less intensive crop management than IVs. This is expected, as IVs may require new management practices. For example, the two IVs, Jalene and Gudane, tend to have larger tuber size, and additional management may be necessary to control tuber size. Furthermore, drought resistance is negatively correlated to the probability of adoption. Due to incidents of irregular rainfall in

the Rift Valley region, it is possible for farmers to perceive that LVs have better adaptation than a new variety. In contrast, farmers' assessment of yield, disease resistance, and maturity period for the LVs does not have a significant relation to adoption decision. However, the relationship would have expected otherwise, as LVs are often considered inferior to yield and disease resistance.

The results show that market-related attributes are more important than yield, disease resistance, and maturity period. Accordingly, stew quality is significantly and negatively correlated to farmers' adoption decisions. Stew quality is expected to be relevant because ware potatoes are commonly consumed in the form of stew in Ethiopia. This result is consistent with estimates of 'use of main buyer as a source of advice'. On the other hand, there is no significant association between farmers' assessment for tuber size and shape and the likelihood of adoption.

Regarding control variables, education level and presence of a radio or television have a significant relationship with the presence of adoption. Education of the head of the household is positively correlated with the probability of adoption, while age has no relationship. The positive contribution of education is expected as famers with more years in school tend to have better information processing capabilities. The household head being male positively contributes to the adoption decision. Furthermore, household characteristics such as presence of a radio or television are positively and significantly correlated to the adoption decision. This was also expected as access to wider information helps to broaden farmers' understandings of new technologies. It is also interesting to note that while family size has a positive impact on adoption, number of livestock units has the opposite. This could relate to the fact that IVs are high yielding but less preferred by buyers. Hence, it is likely that for households with a larger family size (a high number of dependents), IVs might provide a better option for household consumption. It could also be argued that large family size means high labor force, which would positively affect the adoption decision. Households with a large number of livestock units are less likely to participate in adopting the IVs, as this would require additional labor and expertise apart from animal production. However, possession of a motor bike, car, and/or truck and percentage of own land do not have association with adoption decision. Although two-thirds of the respondents had a mobile phone, this has no correlation with the adoption decision. Perhaps, a mobile phone is considered more as a measure of status than as a means to access information.

Persistence of adoption

An Ordered Probit (with OLS estimation for comparison) is used to measure persistence of adoption for the IVs (Table 3.4). Observations were recorded using a recall method.

Table 3.4 Parametric estimation for persistence of growing the IVs between 2006 and 2010

	Years of adoption					
	OLS			Ordered Probit		
Variables	Coef.	Robust Std. Err.		Coef.	Robust Std. Err.	
Frequency of use of technical assistance from extension agents	-0.030	0.054		-0.057	0.090	
Frequency of use of technical assistance from research institutes	-0.054	0.059		-0.090	0.106	
Frequency of use of technical assistance from coops/associations	0.043	0.092		0.118	0.147	
Frequency of use of technical assistance from NGOs	0.423	0.133	***	0.637	0.155	***
Days spent in farmer training centers	0.006	0.005		0.007	0.006	
Main buyer as a source of advice	-0.255	0.059	***	-0.533	0.151	***
Access to credit	0.025	0.095		0.263	0.178	
Yield	-0.003	0.004		-0.005	0.008	
Disease resistance	-0.070	0.060		-0.059	0.124	
Drought resistance	-0.079	0.057		-0.249	0.109	**
Intensity of crop management	-0.234	0.079	***	-0.432	0.119	***
Maturity period	0.003	0.005		0.004	0.008	
Tuber size	-0.092	0.104		-0.062	0.172	
Tuber shape – full round	-0.093	0.130		-0.810	0.499	
Stew quality	-0.145	0.062	**	-0.295	0.112	***
Age	0.005	0.006		0.013	0.009	
Farmer being a male	0.035	0.154		0.104	0.362	
Farmers years of education	0.017	0.015		0.056	0.027	**
Family size	0.016	0.011		0.044	0.021	**
Presence of a motorbike, car and/or a truck	0.001	0.272		0.298	0.436	
Presence of a mobile phone	0.154	0.111		0.217	0.204	
Presence of a radio	0.239	0.090	***	0.590	0.191	***
Presence of a television	0.287	0.166	*	0.440	0.233	*
Percentage of own land	0.002	0.002		0.001	0.004	
Number of livestock units	-0.005	0.002	**	-0.031	0.012	***
Constant	1.354	0.574	**			
N	334			334		
R2	0.773			0.212		

* $p < 0.1$; ** $p < 0.05$; $p < 0.01$.

Comparing Table 3.4 with Table 3.3, access to credit does not influence the persistence of adoption although this variable is important for the adoption decision. However, the significance level of technical assistance from NGOs, drought resistance, family size, and

number of livestock units has improved by one level. Furthermore, stew quality, which negatively affects the adoption decision (Table 3.3), continues to influence the persistence of adoption decision. That means, farmers' assessment about stew quality of the LVs strongly affects the likelihood of growing the IVs in subsequent seasons. Overall, the estimation of the Ordered Probit model is consistent with the OLS estimation.

Intensity of adoption

If information is available on the quantity of a dependent variable, Tobit or Heckman sample selection (treatment effect) model can better explain both the decision to adopt and the extent of adoption (Greene, 2003). However, the Tobit model is prone to two limitations. First, it imposes the effect of explanatory variables to be similar on the decision to adopt and the extent of adoption. Second, the Tobit model assumes the same variables affect the decision to adopt and the extent of adoption. The treatment effect model is suggested to solve both limitations (Green, 2003). The treatment effect model involves two equations – the selection equation, which provides information on what variables could affect the probability of adoption, and the outcome equation, which provides information on what variables could affect the extent of adoption.

To specify the treatment effect model, a Probit and then OLS regression on positive observations (truncated regression) were carried out separately. The variables, which were included in the Probit model, are all considered in the selection equation. The variable 'farmer years of education', which was highly insignificant in the OLS estimation, was dropped from the outcome equation as this is appropriate for proper model identification (Schipmann and Qaim, 2010).

Table 3. 5 Parametric estimation of intensity of adoption (2010): treatment effect model

	Selection equation			Outcome equation as a percentage of					
	Decision to grow IVs			total cultivated			total potato land		
Variable	Coef.	Robust Std.		Coef.	Robust Std.		Coef.	Robust Std.	
Frequency of use of technical assistance from extension agents	0.032	0.109		-0.011	0.009		0.009	0.016	
Frequency of use of technical assistance from research institutes	0.084	0.114		0.024	0.014		0.053	0.040	
Frequency of use of technical assistance from coops/associations	-0.130	0.166		-0.039	0.021		-0.057	0.039	
Frequency of use of technical assistance from NGOs	0.447	0.251	*	0.008	0.019		0.008	0.059	
Days spent in farmer training centers	0.016	0.009	*	-0.001	0.001		-0.001	0.001	
Main buyer as a source of advice	-0.522	0.164	***	0.055	0.035		0.025	0.079	
Access to credit	0.791	0.291	***	0.078	0.035	**	0.172	0.094	*
Yield	-0.015	0.010		0.003	0.002	**	-0.0001	0.003	
Disease resistance	0.058	0.146		0.022	0.015		-0.004	0.031	
Drought resistance	-0.185	0.129		0.025	0.015		0.025	0.032	
Intensity of crop management	-0.346	0.131	***	0.021	0.019		0.023	0.043	
Maturity period	0.008	0.009		0.0004	0.001		-0.001	0.001	
Tuber size	-0.177	0.187		-0.053	0.023	**	-0.106	0.046	**
Tuber shape – full round	-0.381	0.488		0.022	0.071		0.061	0.139	
Stew quality	-0.207	0.140		-0.005	0.013		-0.055	0.034	*
Age	0.012	0.011		-0.001	0.001		-0.001	0.002	
Farmer being a male	0.658	0.466		0.071	0.040	*	0.081	0.119	
Farmer years of education	0.089	0.031	***	-	-		-	-	
Family size	0.037	0.023		-0.003	0.003		-0.003	0.007	
Presence of a motorbike, car and/or a truck	-0.482	0.550		-0.105	0.055	*	-0.013	0.145	
Presence of a mobile phone	0.116	0.234		-0.074	0.031	**	-0.130	0.073	*
Presence of a radio	0.565	0.217	***	0.027	0.029		0.059	0.070	
Presence of a television	0.870	0.299	***	0.047	0.025	*	-0.0406	0.0912	
Percentage of own land	-0.0006	0.0039		0.0019	0.001	***	0.003	0.001	***
Number of livestock units	-0.024	0.014	*	0.002	0.003		-0.002	0.005	
Constant	-0.170	1.337		-0.266	0.147	*	0.372	0.257	
ath (ρ)				-0.352	0.289		-0.072	0.883	
LR test of independent Equations									
Chi-squared (1)				1.48			0.01		
Prob > chi-square				0.224			0.935		
N	334			85			85		

* $p < 0.1$; ** $p < 0.05$; $p < 0.01$.

Table 3.5 presents two outcome equations - land allocated to grow the IVs as a percentage of total cultivated land and as percentage of total land dedicated only for potatoes. Only one selection equation is presented, which is similar to the Probit model in Table 3.3. However, while Table 3.3 displays the presence of adoption representing the period 2006 to 2010, the selection equation in Table 3.5 is only limited to the 2010 data. Hence, the treatment effect

model provides information on what variables could affect the probability of adopting the IVs and what variables could affect the share of land allocated to growing IVs on the same period. The test result of the treatment effect model shows that there is no sample selection bias, as the correlation coefficient between residuals of both equations "ath (ρ)" is not significantly different from zero. The results of the selection equation and the Probit model and the outcome equation and the OLS regression (truncated) are similar; hence, only the results of the selection equation and outcome equation are presented to interpret the results.

The results show that variables like use of main buyer as a source of advice, crop management intensity, farmers' level of education, presence of a radio or television, which are significant at 1% level in the probability of adoption, are found to be less important for the extent of adoption. In contrast, percentage own land and tuber size show a significant relationship with the extent of adoption, which is not the case in the probability of adoption. The extent of adoption is also influenced by access to credit, yield, and presence of a mobile phone.

3.4.2 Discussion

The results showed that 73% of ware potato farmers did not adopt the IVs in the period 2006 to 2010. The first question to answer is whether seed potatoes of the IVs were available and affordable for ware potato growers. First, during the survey, farmers reported that the price of seed potatoes of the IVs was not higher than the price of seed potatoes of LVs. The cost of the IVs (per 100 kg) on average ranged between 8.2 and 13 USD while the cost of the most common LV, Nechi Ababa, was around 9.5 USD. Second, there have been attempts by the Ministry of Agriculture and Rural Development, EIAR, and NGOs to promote the IVs (Ortiz et al., 2013). Abebe et al. (2010) already showed that seed potatoes of the IVs were being produced and put on the market by potato growers in the highlands. Thus, it can be concluded that low availability or a high price was not the main factor that led to low adoption.

The AKIS variables 'frequency of use of technical assistance from NGOs', 'use of main buyer as a source of advice', and 'access to credit' show a significant association with the presence and persistence of adoption, and only access to credit positively influences intensity of adoption. However, this result also shows the lack of coordination within the Ethiopian AKIS. While the focus of research institutes, extension agents, and NGOs is to promote the

IVs among potato farmers, the advice that farmers receive from main buyers appears to affect the adoption of the IVs negatively, implying an adverse effect of potato buyers on the innovation process. This result confirms the claim by Spielman et al. (2011) that private actors are excluded from the innovation system. Lack of coordinated action among research, extension, and buyers apparently creates a tension for ware potato farmers in their decision to adopt new varieties. Contrary to the findings of Adesina and Baidu-Forson (1995) and Zinnah et al. (1993), frequency of use of extension services and technical assistance from cooperatives have no significant effect on the probability of adoption. This confirms previous claims that the extension service in Ethiopia is generally ineffective in inducing technology adoption (Abate et al., 2011; Belay, 2003; Belay and Abebaw, 2004; Dadi et al., 2004). In contrast, Ortiz et al. (2013) documented a positive assessment about the role of extension in the Ethiopian potato innovation system. However, their study was more focused on specialized seed potato growers in the highlands, who often get technical support and seed from EIAR and CIP; hence their results may not necessarily apply to the situation of ware potato farmers in the Rift Valley region. Other studies also found that extension plays a limited role in technology adoption (Kafle and Shah, 2012; Mariano et al., 2012; Ransom et al., 2003; Schipmann and Qaim, 2010). Evidently, findings regarding the role of extension are not similar, implying differences in the way AKIS operates in a particular institutional setting. Considering ware potato farmers' adoption decision as one criterion to measure performance, the Ethiopian AKIS has failed to effectively promote the IVs in the study area.

The results show that crop management intensity is strongly correlated to the adoption decision. IVs may require more intensive crop management, which could adversely affect adoption decisions. For instance, Waller et al. (1998) reported that the non-alignment between traditional crop management and the integrated pest management (IPM) practices that come with the new varieties led to low adoption of those new varieties among potato farmers in Ohio, USA. However, surprisingly crop management intensity turns out to be less important (Table 3.5) when it comes to the extent of adoption, which could be related to the small area allotted to grow the IVs. Also, drought resistance affects the presence and persistence of adoption of new varieties. Under erratic rainfall conditions, farmers tend to rely more on LVs that they know are good in surviving unfavorable climate conditions. Similar results were reported for sorghum farmers, by Adesina and Baidu-Forson (1995), and rice farmers, by Mariano et al. (2012). In areas where rainfall is erratic, introducing water

harvesting technologies is likley to induce the adoption of new varieties (Wakeyo and Gardebroek, 2013).

Surprisingly, other production-related variables such as disease resistance, yield, and maturity period did not have a significant relationship with the presence and persistence of adoption. As to disease resistance, ware potato farmers are generally convinced that all varieties tend to be susceptible to diseases. Furthermore, farmers claim that even though IVs appear less prone to diseases in the first cycle of production, they tend to degenerate faster over successive cropping cycles than the LVs. However, IVs start at a much higher level of quality than LVs. Thiele (1999), in the case of potatoes in the Andes, argued that the use of improved potato seed is profitable only if the farmer can use second and third generation seeds. Regarding yield, the IVs, such as Jalene and Gudane, are generally high yielding. However, just a higher yield does not lead to adoption, as other attributes are also important from farmers' perspective (Waller et al., 1998). However, in one of the outcome equations (Table 3.5), yield appears to positively affect the extent of adoption. This implies that the yield attribute becomes important once farmers have made the decision to adopt the IVs. With regard to maturity period, the IVs Jalene and Gudane on average mature in 122 days while the common LV, Nechi Ababa, matures in 101 days. For farmers depending on rainfall, this difference in maturity period may not be so important. However, a longer maturity period might increase the incidence of late blight and other diseases. This study shows that maturity period does not affect adoption of IVs.

Overall, ware potato farmers' assessment of the LVs on disease resistance, yield, and maturity period played a limited role in their decision to adopt new varieties. It should, however, be noted that this result does not imply that yield, disease resistance, and maturity period are not important in farmers' variety choice; instead, the results show the superiority of market-related quality attributes over production attributes when there are tradeoffs. The results confirm the claim by Schipmann and Qaim (2010) that farmers consider market-related quality attributes as critical factors for adoption. Ware potato farmers' assessment of stew quality of the LVs appears to be the main market-related quality attribute affecting adoption decision. The importance of economic incentives for adoption decisions is also reported by Dadi et al. (2004), in the context of teff and wheat varieties. However, farmers' assessment with regard to tuber size did not have a significant effect on the probability of adoption. This is of a surprise because the IVs Jalene and Gudane tend to have relatively

larger tuber size, which could affect buyers' willingness to buy potatoes. Ware potato farmers generally perceive that with an increasing tuber size stew quality may decrease. Perhaps, the effect of size might have been captured in the stew quality attribute. Nonetheless, we found tuber size negatively influencing the extent of adoption. The explanation is that, once the decision is made to adopt, IVs are likely to be grown in a small plot for own consumption while allocating the large portion of their potato land to grow LVs for a commercial purpose. The findings showed that education is significantly and positively correlated to the probability of adoption. This result is consistent with other studies (e.g., He et al., 2007; Mariano et al., 2012; Thangata and Alavalapati, 2003; Waller et al., 1998). Education can play a crucial role by reducing uncertainty and improving skills (Abadi Ghadim et al., 2005). Likewise, presence of a radio is highly significant in the presence and persistence of adoption. This result is consistent with a study in India, where radio was reported to have improved the adoption of new potato variety, (Adhiguru et al., 2009) but different from Ortiz et al. (2013), who reported that radio played a limited role in adopting new potato varieties among potato farmers in Ethiopia, Peru and Uganda. However, both education and radio have no significant influence on the extent of adoption. In contrast, the presence of a mobile phone, which was not significant in the adoption decision, negatively affects the extent of adoption. While education and radio could allow farmers access to wider information, farmers may use a mobile phone to access limited but important market information from main buyers. As discussed above, buyers do not seem to have a positive perception about the IVs, and subsequently farmers who adopted the IVs and have a mobile phone are likely to grow the IVs in a small piece of land than those who do not have a mobile phone.

3.5 Conclusions

The main aim of this study was to provide insights into the determinants of adopting improved potato varieties in Ethiopia, focusing on the role of the agricultural knowledge and innovation system and ware potato farmers' assessment of local varieties.

The findings show that frequency of use of technical assistance from NGOs, use of main buyer as a source of advice, and access to credit play a key role in ware potato farmers' adoption decision. While technical assistance from NGOs and access to credit induce farmers to adopt the IVs, the use of the main buyer as a source of advice has an opposite effect.

Farmers' assessment of quality attributes of the LVs affects adoption of the IVs. While production-related attributes such as yield and disease resistance are considered highly important by the Ethiopian AKIS, ware potato farmers considered them of secondary importance. Rather, farmers consider crop management intensity and stew quality as the main quality attributes. Among the household and farm controls, education, presence of a radio or television affect adoption of IVs. This finding suggests the importance of access to and ability to process information for adopting new varieties.

This study contributes to the adoption literature as follows. First, the study showed that the introduction of new crop varieties involves a complex problem of coordination between supply and demand factors, in which AKIS and market actors are involved. Second, it showed that the adoption decision by the farmer is a multi-criteria decision problem that involves trade-offs. While AKIS suppliers of new potato varieties tend to focus on agronomic characteristics, farmers also include non-agronomic characteristics, such as stew quality and buyer preferences, in their adoption decision. Third, compared to other staple food crops, there is only limited empirical research on the adoption of new potato varieties by ware potato growers. Following Thiele (1999), potato, with its specific agro-ecological and socio-cultural specificities, deserves more attention. Hence, this study provides insights into the determinants of adopting new potato varieties in the Upper Rift Valley region of Ethiopia.

This study leads to a number of policy recommendations. First, a supply chain view on quality, based on what farmers and buyers' value most, is needed to improve the adoption rate of IVs. The study presents a recommendation for policymakers responsible for setting research agendas and for researchers to put more emphasis on the combination of agronomic and non-agronomic attributes in new variety development. Including the preferences of ware potato farmers and their customers into the process of setting research priorities asks for a participatory research approach. This recommendation is in line with Byerlee et al. (2007) who, in the context of new sorghum varieties, suggested a rethinking of the existing innovation diffusion system in Ethiopia. A second policy recommendation relates to the importance of education and access to information, which proved to be crucial in adoption decisions. Yet, although two-thirds of ware potato farmers in this study had a mobile phone, it did not have a significant effect on the probability of adoption. Institutions involved in the innovation process should therefore put more efforts into the utilization of this technology as part of the innovation system. For instance, Mittal et al. (2010) reported the positive

contribution of a mobile phone in India by disseminating specific information on price, availability of inputs, seed quality, and adoption of modern technologies. A third recommendation focuses on the use of broadcasting media, such as radio and television. As these media turned out to be important for the adoption decision, policymakers could use the recently expanding community level radio stations to educate and promote the adoption of new agricultural technologies.

Chapter 4

Are middlemen facilitators or barriers to improve smallholders' commercialization?

This chapter is based on the article submitted to the Journal of Development Studies as 'Abebe, G.K., Bijman, J., Royer, A., Ruerd, R. and Omta, O. Are middlemen facilitators or barriers to improve smallholders' commercialization?'.

4. Are middlemen facilitators or barriers to improve smallholders' commercialization?

4.1 Introduction

Food value chains in developing countries are experiencing many changes given the rapid development of their supermarkets and the increasing quality and safety import requirements from developed countries (Henson and Jaffee, 2008; Swinnen and Maertens, 2007). These changes represent new market opportunities for agricultural smallholders that can improve the quality and traceability of their products. All around the world, many smallholders are striving to comply with these increasingly stringent requirements. Whether they are successful depends to a large extent on the way production and distribution is coordinated along the value chain (Hernández et al., 2007; Neven et al., 2009; Swinnen and Maertens, 2007). Different institutional arrangements, such as contract farming, vertical integration and producer organizations, have emerged in agrifood chains to successfully address these new challenges (Bijman, 2008; Henson et al., 2005; Moustier et al., 2010). There are, however, still many chains in Sub-Saharan Africa where middlemen play an important role in linking farmers to traders and final markets.

It is widely recognized that intermediaries play an important role in facilitating trade by decreasing transaction costs related to search time and information asymmetry (Dixit, 2009; Gabre-Madhin, 2001; Hayami, 1996; Li, 1998; Rubinstein and Wolinsky, 1987; Townsend, 1978). Middlemen are, by definition, economic actors in-between two other actors (Gadde and Snehota, 2001). Although most work to date, either theoretical or empirical, has inferred a rather positive role to middlemen in trading relations, other studies have been more critical.

Using a game theoretic approach, Townsend (1978) demonstrates that intermediaries emerge endogenously as they allow economizing on the fixed cost of exchange, understood as transaction costs. Rubinstein and Wolinsky (1987) argue that middlemen are a time-saving institution since they shorten the negotiation time of sellers and buyers for a transaction. Introducing the notion of quality uncertainty as in the sense of Akerlof (1970), Li (1998) argues that middlemen do have an advantage in terms of information. Looking at two parameters, the severity of the private information problem and the cost of middlemen's

quality-testing technology, Li explains that if the information problem is not severe and if agents are willing to undertake exchange without knowing the exact quality of the goods, the presence of middlemen in trade is inefficient. However, if the information asymmetry prevents agents from trading since they cannot recognize the quality of the goods, then middlemen can be welfare-improving. Therefore, according to Li, middlemen are an efficient institution in markets where quality is costly to measure.

However, Masters (2008) found a negative effect of middlemen on farmers' income. He argues that the most persuasive and the least productive individuals are the ones who become middlemen. They take advantage of the existence of producers who have lower production costs than themselves, but do not know the market. Under such market conditions, middlemen prosper by 'buying low' and 'selling high'. According to Masters, middlemen are a welfare reducing institution.

In terms of empirical work, recently Abdul et al. (2012) reported the monopoly and monopsony power of middlemen in the context of Pakistani rice market. They argue that middlemen exploit smallholders by imposing their own terms and by representing themselves both as sellers and buyers. In contrast, in line with the argument put forward by Rubinstein and Wolinsky (1987), Gabre-Madhin (2001) finds that middlemen have a positive effect on overall surplus by enabling a more efficient allocation of search effort and therefore constitute a socially optimal choice. Nonetheless, this evidence demonstrates the positive contribution of middlemen from the traders' perspective while empirical studies supporting this view from the side of smallholder farmers are scarce. Furthermore, it is likely that middlemen may behave differently depending on the nature of the crop and the institutional environment. Thus, further research is necessary to assess the (potential) role of middlemen in intensifying smallholders' participation in remunerative and quality-oriented market segments, especially, in the modern economy where farmers are increasingly having access to a mobile phone. More specifically, this Chapter addresses the following research question:

RQ3: *Which factors do influence farmers' decision to use middlemen in their trading relations, and what is the economic impact of such relationship?*

This study examines a case in Ethiopia where middlemen are the dominant institution in the potato value chain. After controlling for selection bias using propensity score matching, the results show that potato farmers who relied on middlemen had 39% lower income per hectare than those farmers who had sold to direct buyers. This finding suggests that the middleman institution might be ill-suited to deal with new challenges in the modern economy and may even prevent the emergence of other forms of governance, such as contracts and preferred seller-buyer relationships, by lock-in farmers in existing relationships in which social switching costs appear to be high.

The main objectives of this study are the following: (1) to investigate the determinants of smallholders' choice to trade through middlemen, and (2) to analyse the impact of trading through middlemen on smallholders' income. To achieve these objectives, a survey was conducted in the fall of 2010 among 345 potato growers in the Rift Valley region of Ethiopia, where potato is the dominant crop and middlemen are highly involved in potato marketing. In the empirical strategy, the study paid due attention to potential selection bias and endogeneity problems.

The chapter is structured as follows. Section 4.2 provides a literature review and discusses the theoretical framework. Section 4.3 details the data and methods. Section 4.4 presents the results and discussion. Finally, section 4.5 provides the conclusions.

4.2 Literature review and conceptual framework

4.2.1 Literature review

In transaction cost economics, institutions emerge to minimize transaction costs (North, 1994; Platteau, 1994; Williamson, 1998). The use of intermediaries is expected to generate a better match of buyers to sellers than unintermediated trade (Biglaiser and Friedman, 1999), and thus is assumed to economize on direct exchanges (Townsend, 1978). According to Hackett (1992), the use of middlemen is likely to enhance efficiency under the following conditions: (1) when demand variance is high and investment in intermediation effort has little effect on demand; or (2) when information on product quality is costly.

Landa (1981) argues that the institution of middleman is a low-cost arrangement that serves as an alternative to contract law or the vertically integrated firm. He further explains the connection between middlemen and social bonding in a society in which members strictly adhere to the code of conduct of the group and have a clear idea of who is an insider and who is not, offering opportunities to a rational trader to trade with middlemen. The middlemen's ethnic status with sellers may become more important under conditions of contract uncertainty and positive transaction costs. However, social ties could also lead individuals to cooperate according to social norms even if this is against their own self-interest (Fehr et al., 1997; Hoffman et al., 1998). Thus, while the use of middlemen may increase economic efficiency by giving transacting parties trust in the relationship, it may also decrease efficiency by, for instance, excluding new entrants from participating in the market or by applying price collusion (McMillan and Woodruff, 1999). Ethnical relationships may create economic inefficiencies in two ways (Fafchamps, 2000); by changing the relative bargaining powers of buyers and sellers, it can create monopolistic pricing; and by only transacting in the group, entrepreneurship is constrained.

Gabre-Madhin (2001) reported, in the case of grain trade in Ethiopia, that middlemen: (1) provide price information, (2) arrange logistics of delivery, (3) grade products, (4) determine the market price, and (5) match buyers and sellers. In the case examined, direct trade between farmers and traders is unlikely since traders are unwilling to engage in exchange without a witness. Furthermore, working without middlemen could lead to a reduction of traders' choice of possible trading partners. Traders have a preference working with a selective group of middlemen, and, in a particular region, traders deal with only a few middlemen in order to control trading relations more effectively. In case of opportunistic behavior from the part of the middlemen, traders can easily punish them, for example, by excluding from further trading relationships. Furthermore, Gabre-Madhin (2001) documented that traders in the grain market purchase only 30% of their total supply through middlemen, implying that traders also have the choice to buy directly from farmers, through middlemen, or in a combination of both. On the other hand, Minten et al. (2010), in the context of Indian horticulture wholesale market, documented a contrasting finding that middlemen play a limited role with regard to price information, logistics or grading services. The main reasons for the limited role of middlemen mentioned by these authors are: (1) presence of blurred roles between middlemen and traders, (2) little information sharing between farmers and

middlemen before coming to the market, (3) little effect of quality inspection by middlemen as traders would eventually check quality at the time of delivery, and only observable quality characteristics are considered in the exchange, and (4) most farmers and traders have a mobile phone; thus middlemen have a limited role in the reduction of search costs.

Overall, the literature provides mixed evidence about the role of middlemen in smallholders' trading relations with buyers. This raises empirical questions and calls for further investigation into the economic value of the institution of middleman.

4.2.2 Conceptual framework

Smallholders' decision to sell to a direct buyer (seller-buyer) or through a middleman (seller-middlemen-buyer) can be conceptualized as a binary channel choice decision problem by farm households that try to maximize utility. Most of the empirical literature on smallholder farmers' channel choice emphasizes the effect of transaction costs and socio-economic factors such as risk preferences, asset holdings, labor requirements, sales volume, profit margin, and geography (Alene et al., 2008; Barrett, 2008; Fischer and Qaim, 2012; Gabre-Madhin, 2001; Hernández et al., 2007; LeRoux et al., 2010).

This study considers several variables related to human capital (age and education level), access to information, (access to a mobile phone and membership in a cooperative, social bonding (ethnic ties), access to market (location specific dummies and distance from farm to main road), quality (varieties grown), resource endowment (labor, presence of a horse/donkey cart, and number of livestock units), and variables capturing quality and volume of production (variety type and cultivated area). Summary statistics for these variables are presented in Table 4.1.

Age and education level are used as a proxy for human capital (Fischer and Qaim, 2012). Middlemen are generally considered important providers of market information. It is expected that the probability of using middlemen diminishes with farmers' age and education level, because older and better educated farmers tend to have more experience and assessment skills about buyers' demands (Monson et al., 2008). As lack of access to market information is one of the major problems of smallholder farmers, farmers who have access to information is expected to be less dependent on middlemen. For instance, Muto and Yamano

(2009) found that mobile phone technology induced market participation of farmers living in remote areas and producing perishable crops. Likewise, membership in a cooperative could provide better access to price information (Kassie et al., 2011). Thus, members of a cooperative are expected to be less dependent on middlemen.

Social bonding, such as ethnic ties, plays a significant role in trading relationships (Ali and Peerlings, 2011; Cornell and Welch, 1996; Fafchamps, 2000). Social bonding established through ethnic ties creates homogeneity and thus could positively impact business outcomes by reducing transaction costs (Annen, 2003; Fafchamps, 2000). However, such relationships could also negatively affect business outcomes as ethnically tied farmers may continue trading with middlemen even if it is not in their best economic interest (Fehr et al., 1997; Hoffman et al., 1998), because ethnic ties can lead to lock-in in the sense explained in the marketing literature (Bansal et al., 2004; Jones et al., 2007). According to Jones et al. (2007), personalized relationship creates lock-in effects because of high social switching costs such as potential loss of a personal bond or friendship. Lock-in can lead to welfare losses since it creates ex post monopoly or monopsony (Barrett, 2005) and thus opportunity for exploitation.

The study used location dummies and access to an all-weather road as a proxy for access to market (Hagos et al., 2012). Accordingly, farmers who are close to the potato market are less likely to rely on middlemen since they are better positioned to find a direct buyer. Regarding product quality, the type of variety is used as an objective measure of potato quality. In the study area there are several varieties. From these varieties, variety 'Nechi Ababa' is the most common commercial variety supplied to the wet market in Addis Ababa and to other major cities. Because of the market demand for this variety, farmers that grow 'Nechi Ababa' are more likely to deal with direct buyers and to be less dependent on middlemen. Furthermore, volume of production can influence the choice of a trading partner. Accordingly, farmers who have high production volume are more likely to use intermediation than those farmers with low production volume because of the high market risk. In terms of resource endowment, farmers who have a horse or donkey cart are more likely to deal with direct buyers because they can transport their potatoes to the nearest market should they do not find a direct buyer at farmgate. Likewise, a large family size could provide more labor to carry potatoes to the nearest collection center if they do not find a buyer at farmgate (LeRoux et al., 2010) and thus are less likely to be dependent on middlemen. Also, farmers with a large number of

livestock units are more likely to use middlemen because of the high opportunity cost of labor to search for a buyer (Fafchamps and Hill, 2005).

4.3 Data and Methods

4.3.1 Data

Study context

West Arsi-zone, in the Rift valley region of Ethiopia, is one of the major potato growing regions in the country in which middlemen are highly involved in the potato market. In this region, middlemen constitute a 'hidden population'. As a result, no official data can be found about their number. It appears that middlemen opt to work informally mostly because they do not want to pay registration fee or taxes on commission. The most common type of intermediation in the study area is the one between potato farmers and traders. By representing potato traders, middlemen can match buyers and sellers and negotiate farmgate prices. However, the actual harvesting is carried out by the traders' hired labor. In return, middlemen receive commission from traders, but not necessarily from the farmers. Potato middlemen do not bear any market or production risk.

Data collected among 107 middlemen showed that the average age of middlemen was 27 years and had education level of junior high school or less, mostly dominated by men and one ethnic group. Prior occupation of the middlemen consisted of 44% farmers, 41% students, and 15% ex-soldiers. A single middleman on average intermediated with about 79 potato farmers and seven traders in 2009/2010. Based on self-perception of middlemen, 35% stated that they would take the position of traders when negotiating prices, while only 17% responded to favor farmers; however, 46% of middlemen stated that they would take a neutral position.

Data

Data were collected in the spring of 2011 among ware potato farmers. A total of 350 potato farmers, from purposely selected 16 high potato growing peasant associations[8] located in the Shashemene, Shala, and Shiraro districts, participated in the survey. Potato farmers were randomly selected from the land ownership register obtained from the Office of Agriculture and Rural Development in the three districts. In the event of unavailability of a farmer, the next farmer in the register was included in the survey. The study used a proportional random sampling approach, based on the concentration of potato production, when selecting farmers from the three districts and 16 peasant associations. After testing the questionnaire, the survey was conducted using a personally administered structured questionnaire. Data from five potato farmers were dropped during data cleaning.

4.3.2 Empirical model for determinants of using middlemen

Before introducing the empirical model, it is important to note how ware potato transactions take place in the study area. Farmers can sell their potatoes in nearby markets to anonymous buyers or at farmgate to collecting wholesalers. The majority of farmers sell their potatoes at farmgate at a predetermined price (before harvest). Those farmers who sell at farmgate have two options – to sell their potatoes through middlemen or directly to collecting wholesalers (direct buyers). While the study of Fafchamps and Hill (2005) focused on analyzing the factors affecting smallholder (coffee) farmers' decision to sell in nearby spot markets and at farmgate, the present study focuses on the factors affecting potato farmers' choice of a trading partner at a farmgate, where some farmers sell through middlemen and the others sell to direct buyers. Direct buyers refer to traders (mostly collecting wholesalers) who buy directly from farmers without involving middlemen.

Turning to the estimation strategy, in the presence of a representative middleman who engages in trade, farmers can choose whether to use middlemen (seller-middlemen-buyer relationship) or sell to direct buyers (seller-buyer relationship). However, the actual level of

[8] A peasant association covers around 800 hectare of land (Hagos *et al*. 2012), and is the lowest administrative unit in Ethiopia.

utility for each farmer U_i is not observed. The part of each farmer's utility function that is observable can be expressed as a function of a vector of exogenous variables X_i and a vector of parameters β to be estimated:

$V_i(\beta' X_i)$, where $\quad U_i = V_i(\beta' X_i) + u_i$ (1)

X_i represents a vector of socio-economic characteristics; and u_i is the unobservable portion of the farmer's utility, which is assumed to be independently and identically distributed.

A farmer will choose to sell his potatoes through middlemen if the utility gained from intermediation, U_i^M, is greater than the utility from direct selling, U_i^D. The probability of a farmer selling his potatoes through a middleman is given by $p(u_i < \beta' X_i)$. The fact that the error term is modeled to have a standard normal distribution motivates the use of a probit model (Wollni and Zeller, 2007). Thus, the model to be estimated is given by:

$p(M_i = 1) = p(u_i < \beta' X_i) = \beta' X_i + u_i$, for i = 1, . . ., N, (2)

where $M_i = 1$ if $U_i^M > U_i^D$, and $M_i = 0$ if $U_i^M \leq U_i^D$

4.3.3 Empirical model for the impact of middlemen on farmers' income

Propensity score matching

The study seeks to estimate the impact of smallholders' use of middlemen on farmers' income from potato sales. To achieve this objective, a counterfactual approach is followed to estimate the average treatment effect on the treated (ATT) (Heckman et al., 1997), as it cannot be observed how farmers' income from potato sales would have looked like without using middlemen. Furthermore, it cannot be compared the outcomes of both groups of farmers as a farmer's decision to use a middleman is of a non-random nature and thus could lead to a selection bias. Non-parametric statistical approaches are suggested to address the problem of self-selection bias related to non-random observational studies (Heckman et al., 1997).

The sources of selection bias could relate to non-overlapping supports, unbalance in observed and/or unobserved confounders between the treated and the comparison groups (Caliendo and Kopeinig, 2008). This bias could be reduced by adjusting the difference in the outcome variable due to pre-treatment characteristics using propensity score matching (PSM), which is the most commonly used method in this type of analysis (Heckman et al., 1997; Rosenbaum and Rubin, 1985; Sianesi, 2004). Thus, the study compares the gross income per hectare between both groups of farmers from potato sales realized in the preceding year (2009/2010). PSM helps to achieve a better estimation of the treatment effect, and provides comparison of the treatment effect controlling for the potential bias arising from self-selection. However, this only holds if the identifying assumptions, namely the Conditional Independence Assumption (CIA) and Common Support, are sufficiently met (Caliendo and Kopeinig, 2008). CIA takes a strong assumption that all variables that influence treatment assignment and potential outcomes simultaneously are observed by the researcher, while the common support condition ensures that persons with the same observable values have a positive likelihood of being part of both in the treatment and comparison groups (Heckman et al., 1999).

When the CIA and common support condition hold, the difference in outcomes between the treatment and the control group is given by the PSM estimator of ATT as follows:

$$\tau_{ATT}^{PSM} = E_{P(X)|C=1}\{E[Y(1)|C = 1, P(X)] - E[Y(0)|C = 0, P(X)]\} \quad (3)$$

Where Y(1) and Y(0) are values of the outcome variables of interest for the treated (farmers who use middlemen) and control (farmers who sell to direct buyers without involving middlemen), respectively. Likewise, C = 1 and C = 0 refer to respectively treated and controlled farmers.

Following Caliendo and Kopeinig (2008), the implementation of the PSM in this study follows several steps. The first step is the choice of models and variables to be included in the model. Therefore, the propensity scores are estimated using a probit model since both probit and logit models yield similar results for a binary treatment case (Smith and Todd, 2001). For the variable choice, several authors suggest that only variables that simultaneously influence participation decisions and the outcome variable, and variables that can be derived from

theory, empirical studies or institutional settings should be included (Caliendo and Kopeinig, 2008; Heckman et al., 1997; Smith and Todd, 2005). Thus, variables that are either fixed overtime or measured before participation should be part of the model, and data for the treatment and control group should come from the same source (Heckman et al., 1999) to ensure that the variables in the model are unaffected by the treatment (or anticipation of it). Furthermore, the treatment and comparison groups must operate in the same market environment (Bernard et al., 2008; Heckman et al., 1998). Regarding the number of variables, however, there are two views. While Bryson et al. (2002) argue that overparameterized models should be avoided because this can increase variance, Rubin and Thomas (1996) advice that a variable should only be excluded if either unrelated to the outcome or not a proper covariate. This study included all the covariates of the probit model to predict the propensity scores, following Uematsu and Mishra (2012).

The second step in the PSM is the choice of matching algorithm. In this regard, various methods have been proposed, such as the nearest-neighbor (NN) matching, radius matching (RM), and kernel matching (KM). The NN matching can be performed with or without replacement. The former improves the average quality of matches and reduces bias, but increases the variance of the estimator (Smith and Todd, 2005). With RM, however, the nearest neighbour is not only within each calliper but all the comparison members within the calliper. While both NN matching and RM use only a few observations from the comparison group to construct the counterfactual outcome of the treated variable, the KM approach uses weighted averages of all indivduals in the comparison group to construct the counterfactual outcome (Caliendo and Kopeinig, 2008). KM yields lower variance but could lead to bad matches, and thus requires the choice of an appropriate bandwidth to satisfy the common support condition. In general, the choice of PSM algorithm depends on the data structure. While in large sample size asymptotically all PSM algorithms should yield the same results, the choice of the matching algorithm is important in small sample size settings because of the trade-offs between bias and variance (Heckman et al., 1997). The study estimates the income effect using the RM matching because it uses not only the nearest neighbor within each caliper but also all of the comparison members within the caliper (Dehejia and Wahba, 2002). RM allows for usage of extra (fewer) units when good matches are (not) available (Khandker et al., 2010) and thus avoids the risk of bad matches in the NN matching in case the closest neighbor is far way (Caliendo and Kopeinig, 2008).

The third step involves checking of the common support condition. Lechner (2001) suggests a visual analysis of the density distribution of the propensity score in both the treatment and control groups. In this analysis, the study imposes the common support condition to satisfy the balancing property. The fourth step in the empirical strategy is to assess the quality of matching. Thus, the study uses several quality indicators such as standardized bias, t-Test, and bootstrapped standard errors (Lechner, 2002; Rosenbaum and Rubin, 1985). The fifth and final step in the PSM is sensitivity analysis. This study estimates the ATT using alternative matching algorithms, NN matching and KM. Also, the study uses Rosenbaum bounds to test the senstivity of estimates for possible unobervable covariates.

4.4 Results and discussion

4.4.1 Descriptive statistics

Table 4.1 provides summary statistics for the variables used in the analysis. Of the randomly selected 345 farmers, 68% sold their potatoes through middlemen during the 2009/2010 production cycle. Table 4.1 shows that gross income from potato sales was higher for farmers that did not use middlemen. Other major differences were related to number of livestock units, ethnic ties, and location dummies. With regard to the latter, most of the farmers in the sample were from Shashemene district because of the high concentration of potato production compared to Shala and Shiraro districts.

Table 4.1 Variable definition and descriptive statistics of potato farmers

Variable	Selling directly to buyers		Selling through middlemen	
	Mean	SD	Mean	SD
Gross income per hectare from sale of potato (in birr[a])	10346	10064	8761	7116
Age of the household head (in years)	36	10.4	37	10.6
Male headed household (1 = yes; 0 = otherwise)	0.94		0.98	
Family size	9.32	5.12	9.71	5.2
Education in school years (household head)	5.42	3.44	5.8	3.6
Total livestock units	14.7	28.4	5.0	5.1
Distance from potato farm to main road (in km)	1.3	1.8	1.0	1.9
Cultivated potato area in 2006 (ha)	1.33	1.2	1.06	0.9
Presence of a mobile phone (1= yes; 0 = otherwise)	0.63		0.69	
Presence of a horse or donkey cart (1 = yes; 0 = otherwise)	0.44		0.4	
Type of potato variety (1= Nechi Abeba[b]; 0 = otherwise)	0.59		0.67	
Membership in a Cooperative (1= yes; 0 = otherwise)	0.5		0.58	
Household head has ethnic ties with main middleman or buyer (1 = yes; 0 = otherwise)	0.31		0.74	
Farmer did not switch to a new buyer at least in the last two years (1= yes; 0 = otherwise)	0.42		0.58	
Farmer is from Shashemene district (1 = yes; 0 = otherwise)	0.72		0.63	
Farmer is from Shiraro district (1 = yes; 0 = otherwise)	0.12		0.26	
Farmer is from Shala district (1 = yes; 0 = otherwise)	0.16		0.11	

[a] 1US$ was approximately equal to 12.60 birr in 2009/2010. [b] Nechi Abeba is the most important commercial (local) potato variety in the study area.

4.4.2 Probit Estimation

Table 4.2 displays the observable characteristics used to analyze the determinants of farmers' choice of a trading partner. Before discussing the results, it is important to note potential concerns of endogeneity in the probit model.

The variable related to ethnic ties is a suspect for endogeneity, because a farmer's response to the question whether s/he has ethnic ties with the main buyer or middleman may depend on the identity of the trading partner. Therefore, this variable has to be instrumented by another observable variable that is correlated with the endogenous variable (ethnic ties) and exogenous to the dependent variable (farmer's choice of a trading partner). In this regard, the study used a dummy variable 'switched to another buyer' as an instrument. Respondents were asked whether they had only one buyer over the last two years or had switched to different buyers. This instrument is relevant in this context because social ties can make switching costs high and may lock-in trading partners in the relationship. A farmer's answer to this question does not necessarily depend on the identity of a trading partner and thus can be

reasonably assumed exogenous to the probability of choice (the farmer's decision to trade through middlemen or sell to direct buyers). The study tested the strength of the instrument statistically. However, the standard stata command for probit models 'ivprobit' fits only when the endogenous variables are continuous, but not appropriate for discrete endogenous variables. As a result, this study used a linear probability model (provided in stata command 'ivreg2') to assess the strength of the instrument (Nichols, 2011; Rivers and Vuong, 1988). Furthermore, this study is more interested in to test the weak instruments, which is a property of the first stage; thus assuming a linear probability model does not pose much problem (Nichols, 2011). The diagnostics tests based on ívreg2' are reported below Table 4.2. The underidentification test (an LM test) shows that the null hypothesis is rejected (i.e., the excluded instrument is correlated with the endogenous variable and the model is identified). Also, the weak identification test (Cragg-Donald Wald F statistic) shows that the instrument is sufficiently strong.

Table 4.2 Estimates of the probit model (1=selling through middlemen; 0= selling directly to buyers)

Variable	Coef.	Robust Std. Er.
Age of the household head (in years)	0.019*	0.011
Male headed household	0.534	0.394
Family size	-0.011	0.021
Education in school years (head)	0.075***	0.029
Total livestock units	-0.079***	0.021
Presence of a mobile phone	0.16	0.191
Presence of a horse or donkey cart	-0.1	0.188
Type of variety	0.168	0.168
Membership in a Cooperative	0.212	0.163
Distance from potato farm to main road	-0.067	0.042
Household head has ethnic ties with the main middleman or buyer (instrumented)	0.65***	0.161
Farmer is from Shashemene district	-0.242	0.285
Farmer is from Shiraro district	0.707**	0.301
Potato cultivated area in 2006 (ha)	-0.224**	0.111
_cons	-0.702	0.619
Wald chi2(12)	62	
Pseudo R2	0.24	
Observations	345	
Underidentification test (Anderson canon. corr. LM statistic):		17.603
	Chi-sq(1) P-val =	0.0000
Weak identification test (Cragg-Donald Wald F statistic):		17.743
Sargan statistic (overidentification test of all instruments):		0.000
	(equation exactly identified)	
Endogeneity test of endogenous regressors:		5.605
	Chi-sq(1) P-val =	0.0179
Instrumented: ethnic ties		
Excluded instruments: not switched to new buyers		

* p < 0.1; ** p < 0.05; *** p < 0.01.

Another suspect for endogeneity is volume of production. It is likely that a farmers' decision to trade through middlemen or sell to direct buyers depends on the volume of production (or quantity to be sold), which is approximated by potato area. Following Rivers and Vuong (1988) and Hernández et al. (2007), the study used the potato area cultivated in 2006 production season (lagged variable) as a proxy to volume to avoid a potential endogeneity problem related to the current period (2010).

The variable membership in a cooperative is less likely to be endogenous as cooperatives in the study area provide only general services (not market outlets for the potato crop), and membership is exogenous in which all farmers have equal chance to participate. Regarding the variables related to access to a mobile phone and number of livestock units, it could be argued that a farmer's choice of a trading partner has led to accumulate wealth to buy these assets. However, this is remote as wealth accumulation also depends on several other factors (e.g., saving, expenditure, etc.), and potato is only one of the several agricultural practices generating family income (e.g., sale of other crops, cattle, etc.). Farmer's decision to grow a specific variety is also exogenous to a farmer's choice of a trading partner because most of the farmers grow more or less the same variety and sell to similar (or same) buyers. The remaining variables are related to location, individual or household's characteristics and thus there is no reason to suspect the problem of endogeneity.

The estimated probit model also satisfied the balancing property specified by Becker and Ichino (2002). Against the expectation, older (but only marginally) and educated farmers rely on middlemen rather than selling to direct buyers. Perhaps, older farmers appear to minimize the risk of searching for a buyer in the absence of intermediation. Likewise, for educated farmers, the opportunity cost of searching for a buyer appears to be high. For instance, educated farmers are more likely to engage in community leadership position such as in cooperatives and local administrative units. Also, the result showed that farmers with large livestock units are less likely to use middlemen. It appears that large livestock units would give farmers some insurance against any downside price risk in the event that they are unable to get a buyer. On the other hand, there is no significant correlation between those farmers having a donkey or horse cart and the choice of trading partner. This perhaps could relate to the nature of potato sales arrangement in the study area. It was observed that the majority of farmers sell their potatoes at farmgate in which the buyers take responsibility in arranging transportation. Likewise, family size showed no significant relationship with the probability

of choice. This might be because harvesting of potatoes is usually carried out by buyers' hired labor force due to quality related concerns. That is, traders hire daily laborers who can harvest and then load potatoes in a truck in the same day so that potatoes can be delivered fresh to the market in Addis Ababa and other major cities in the country. Variety type was used in the estimation as a proxy for difference in quality. However, there is limited variability between farmers who sell through middlemen or to direct buyers; both groups of farmers mostly supply the main commercial local variety 'Nechi Ababa'. Nonetheless, lagged potato area is significantly correlated with a farmer's choice of a trading partner. Thus, a farmer with high volume of production appears to prefer to sell to direct buyers rather than selling through middlemen. This could be because the study area is known for potato production and thus buyers normally would go to the area every harvest season. Thus, large-scale farmers are more likely to attract direct buyers because of economies of scale.

Ethnic ties has a significant relationship in the choice of trading partner. Thus, farmers who have ethnic ties with the main middleman are more likely to use middlemen in their trading relation than those farmers who are not ethnically tied. Likewise, district dummy related to Shiraro shows a significant and positive relationship with the use of middlemen. Thus, a farmer from Shiraro district has a higher chance of using middlemen than a farmer from Shala district, ceteris paribus. This makes sense because Shiraro is approximately located 60 km far from Shashemene, which is the main trade hub of (ware) potatoes, and 25 km far from Shala district. On the other hand, distance to main road did not have a significant effect on farmers' use of a trading partner, both groups of farmers had potato farms located close to the main road. Likewise, membership in a cooperative and the household head being male did not significantly affect farmers' choice of a trading partner. Particularly, the study would have expected cooperative membership to be negatively correlated with the use of middlemen because members are assumed to have better access to information and market. This, perhaps, could be due to the ineffectiveness of cooperatives in Ethiopia for improving smallholders' commercialization (Bernard et al., 2008; Ruben and Heras, 2012). Also, having a mobile phone did not have a significant effect in farmers' decision to use middlemen. This may indicate that access to price information is not necessarily the main reason in smallholders' choice of a trading partner. The results showed that there is limited variability regarding access to a mobile phone between the two groups of farmers.

4.4.3 Average treatment effect on the treated

The average treatment effect on the treated (ATT) is reported using the radius matching algorithm. The ATT is computed based on gross income per hectare of potato land as this study could not obtain detailed production cost data from each farmer. Nonetheless, the cost structure of individual farmers is not expected to vary much. They all use family labor, apply fertilizer, use the same local variety, Nechi Abeba, particularly for commercial purpose, and harvesting, loading, and transporting is usually carried out by buyers' own hired labor force. Furthermore, the study controlled for location-specific variables regarding access to market, family size for labor related costs, and potato variety for quality related costs.

In the following, the quality of the matching is discussed before interpreting the results. First, the common support assumption needs to be checked, following Abebaw and Haile (2013). Accordingly, the predicted propensity scores for the whole sample range between 0 and 0.996, with a mean score of 0.687 (SD=0.013), while the predicted propensity scores for the treated and comparison groups range from 0.023 to 0.996, with a mean of 0.775 (SD=0.17), and 0 to 0.96, with a mean score of 0.496 (SD=0.26), respectively. Thus, there is enough evidence to believe that the common support condition is satisfied. Observations which fall outside of the region [0.023, 0.96] are dropped (18 from the treatment group and 0 from the control group) from the analysis. Figure 1 presents the region of common support.

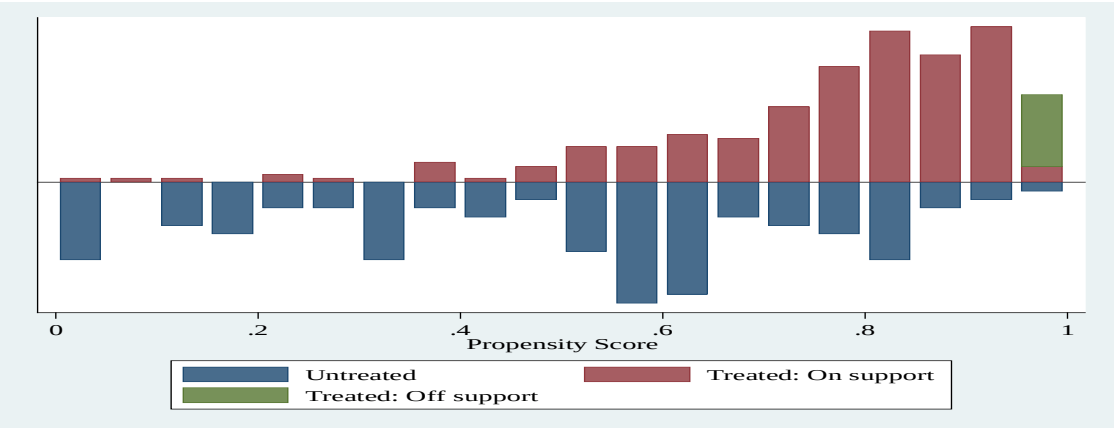


Figure 4.1 Distribution of propensity scores

Table 4.3 Matching quality indicators before and after matching

Matching estimator	Pseudo-R2		LR^2 of probit model		Observation retained	Mean standardized bias		Total % |bias| reduction
	Before	After	Before	After		Before	After	
Radius matching								
Caliper = 0.05	0.24	0.01	103 (p=00)	3.7(p=0.99)	327	19.3	3.0	84
Nearest neighbor								
Two neighbor	0.24	0.01	103 (p=00)	5.9(p=0.96)	327	19.3	4.7	76
Kernel matching								
Bandwidth =0.02	0.32	0.01	103 (p=00)	4.2(p=0.99)	327	19.3	4.1	79

Notes: Estimations for the propensity score, covariate imbalance testing and the common support graphing for the different types of matching estimators were performed by using the program psmatch2 (Leuven and Sianesi, 2012) provided by stata 12.0 software.

As can be observed from Table 4.3, the overall mean standardized bias was reduced from 19.3% before matching, to 3 to 4.7% after matching, with a total bias reduction of 76 to 84%. Similarly, the p-values of the likelihood ratio test that show joint significance of covariates was rejected after matching, whereas the pseudo-R^2 was reduced from 0.24 to 0.01. Also, comparison of individual covariates after (radius) matching shows that the balancing condition is satisfied[9]. This shows that users and non-users of middlemen services are not statistically different on the observable characteristics after matching. According to Rosenbaum and Rubin (1985), the balancing condition is successful if it results in a bias less than 20% for all covariates (Table 4.4).

Table 4.4 Test of matching quality after matching

Variable	Treated	Control	% bias	p-Value after matching
Age of household head (in years)	37.2	38.0	-8.2	0.40
Male headed household	0.98	0.97	3.4	0.66
Family size	9.73	9.87	-2.7	0.77
Education (in school years)	5.72	5.44	8.1	0.42
Total livestock units	5.15	5.48	-1.6	0.49
Presence of a mobile phone	0.68	0.71	-5.3	0.57
Presence of a horse/donkey cart	0.42	0.38	8.8	0.35
Variety type	0.67	0.71	-7.7	0.41
Membership in a Cooperative	0.56	0.56	1.4	0.89
Distance from potato farm to main road (in km)	1.04	0.86	9.7	0.29
Household head has ethnic ties with the main middleman or buyer	0.55	0.54	1.4	0.89
Farmer is from Shashemene district	0.67	0.65	4.9	0.61
Farmer is from Shiraro district	0.21	0.23	-4.7	0.65
Farmer is from Shala district	0.11	0.12	-1.3	0.88
Potato cultivated area in 2006 (ha)	1.06	1.08	-1.4	0.87

[9] The balancing condition is also satisfied for the other matching algorithms, but is not reported because of space.

The impact of using middlemen on farmers' income

A comparison of gross income[10] between farmers who used middlemen and those who sold to direct buyers shows that the latter have earned on average 3,484 birr (277 US$) more, which is equivalent to 39%, income per hectare in the year 2009/2010 (Table 4.5). One may argue that farmers selling to direct buyers incur additional costs such as to search for a buyer. However, the region where this study was conducted is known for potato production. Hence, buyers go to this area every harvest season, and in most cases harvesting is carried out by buyers. Furthermore, many of the farmers have built relationships with buyers and have access to a mobile phone, which makes it easier to search for a buyer. Yet, it could be possible that potato traders do not want to put at risk their relationship with middlemen for at least two reasons. Firstly, direct buying may not guarantee sufficient supply and thus may put the traders in a low competitive position as most of the trade is commissioned by other traders. Secondly, as middlemen tend to favor traders when negotiating with farmers about prices, buying through middlemen is the optimal choice for potato traders.

Table 4.5 Average treatment effect for the treated based on radius matching (caliper =0.05)

Variable	Farmers selling through middlemen	Farmers selling to direct buyers	ATT	SE[a]
Gross income per hectare from potato sales in 2009/2010 (in birr[b])	8,793	12,277	-3,484**	1,748
Off- farm income (including from sale of livestock) in 2009/2010 (in birr)	2,137	5,110	-2,973	2,052

[a] Standard errors are bootstrapped with 500 replications. * p < 0.1; ** p < 0.05; *** p < 0.01.
[b] 1US$ was approximately equal to 12.60 birr in 2009/2010.

As reported in Table 4.5, farmers appear to be economically better off in the absence of middlemen. The study also noted that middlemen are highly involved in the potato market, but not so much in the market for other crops, at least in the study area. This may be explained by the perishability of potato which gives a room for opportunistic behavior (Masten, 2000). Unlike other crops, ware (consumption) potato is difficult to store as farmers do not have the technology to do so, and potatoes are bulky to transport. With regard to off-farm income, the average income for the comparison group exceeds the treatment group by

[10] Gross income per hectare was computed based on farmers' response to the question that how much cash they received (net of transportation costs) from sale of potato produced in previous season. Then the total cash income was divided by the potato area during the same year. For comparison purpose, potato cash income per unit of area was converted into gross income per hectare. The term gross is used because the study did not account for the cost of production.

2973 birr (236 US$) in the same period. This also implies that farmers that sell to direct buyers are relatively earn higher income than those farmers using middlemen. This is indeed not surprising as the farmers that sell to direct buyers also have high number of livestock units as reported in Table 4.1.

In the estimates, the study accounted for the difference in area coverage by comparing only income per hectare rather than total income. The difference in income per hectare between the treated and the comparison group could be attributed to one or more of the following factors. First, intermediation may favor traders; thus the price received by farmers could be lower than in the absence of middlemen. This scenario is likely to happen because middlemen normally receive commission from traders (not from sellers); thus, middlemen have the incentive to set a price lower than the market price in order to negotiate higher commission from traders. Second, the study accounted for the difference in potato quality by controlling only the type of variety grown. Nonetheless, farm management practices can have a significant effect on quality. Thus, it is possible that those farmers who put low efforts on farm management practices (and thus produce low quality potatoes) could choose to sell through middlemen. However, this is unlikely as the middlemen do not want to risk their relationship with traders by selling low quality potatoes. Third, selling through middlemen could be indeed inefficient. This is a plausible scenario because potatoes are largely delivered to the wet market in which only observable characteristics such as tuber size, color, and physical damage of potatoes determine quality. This implies that the use of middlemen in the trading relationship for the purpose of verifying quality is not efficient. According to Li (1998), if information on verifying quality is not severe, the presence of middlemen in trade is inefficient. Thus, by using their services farmers directly or indirectly receive low net price. To substantiate this view, the study gathered additional data regarding the services farmers receive from middlemen. As can be observed in Table 4.6, middlemen in effect provide limited quality enhancing services.

Table 4.6 The type of services provided by middlemen (based on farmers' response)

Type of services	% yes (n=236)
Credit	3.8
Training	2.5
Inputs	0
Storage services	0
Transportation services	3.8
Guarantee against cheating	26.7

The question then is why farmers still continue to sell through middlemen as they would be economically better off in the absence of middlemen. As shown in Table 4.6, middlemen offer (or arrange) almost no credit, training, inputs (e.g., fertilizer), storage, or transportation services. Furthermore, for potato farmers in the study area, searching for price information or a buyer has become less important nowadays than before due to the availability of mobile phones. The study showed that 65% of sampled farmers had access to a mobile phone. This finding suggests that the use of middlemen is mainly motivated by other factors than seeking for market information. In view of this, ethnic ties appears to explain better than economic incentives in smallholders' choice of a trading partner. While 74% of the farmers that sold potatoes through middlemen had ethnic ties with the main middleman, only 31% of farmers in the comparison group maintained ethnic ties with the main potato buyer. The finding is consistent with that of Ali and Peerlings (2011) who argued that the negative effects of closed social networks exceed that of the positive effects, such as the reduction of transaction costs. Ethnically tied relationships can lead individuals to cooperate according to social norms even if this is against their own self-interest (Fehr et al., 1997; Hoffman et al., 1998). Sometimes a person who is closer could be more vulnerable than that of a stranger. Granovetter (1985) argues that although social relations may lay a necessary condition for trust and trustworthy behavior, such trust may present enhanced opportunities for 'malfeasance'. Furthermore, social ties can restrict business exchanges to few agents who can manipulate the exchange process, for instance, by controlling information on prices and markets (Alesina and La Ferrara, 2005).

The results do not lend support to the findings of Gabre-Madhin (2001) that middlemen constitute a socially optimal choice. However, the present study differs in at least two ways. First, Gabre-Madhin (2001) focuses on the role of middlemen from the traders' perspective. Thus, it could be possible that middlemen may minimize traders search time but still use asymmetric power relationship against farmers. Second, the study was carried out in the grain market in which perishability is less a problem compared to ware potatoes. Thus, it is possible that middlemen may behave differently depending on the market in which they operate. Nonetheless, the results reinforce the claim that the use of middlemen becomes more significant when buyers and sellers are unknown to each other or in periodic markets with extremely limited infrastructure.

Sensitivity of the ATT result

As part of the sensitivity analysis, the study reports the ATT based on alternative matching algorithms (Table 4.7). These analyses were carried out with the imposition of common support, bootstrapped standard errors of 500 replications. The implementation of the common support has resulted in exclusion of 18 potato farmers. The gross income per hectare is similar in the three estimators[11], confirming the robustness of the estimates to different matching algorithms.

Robustness of the ATT estimate for hidden bias

The choice of matching algorithm is not robust against 'hidden bias', and thus the study uses the bounding approach proposed by Rosenbaum (2002) to determine how strongly an unobservable variable would have influenced the outcome. The Rosenbaum bound is reported in Appendix 4.1. As shown in Appendix 4.1, the null hypothesis that the outcome variable is related to unobservable covariates is rejected. Thus, the presumption that only observable covariates significantly affect farmers' decision to use middlemen is plausible.

Table 4.7 Robustness of ATT results

Matching algorithms	Observation retained[12]	ATT on gross income (birr per hectare)	Matching condition
Radius matching (with replacement)			
Calliper = 0.01	305	4,122** (1,878)	Satisfied
Calliper =0.03	327	4,103** (2,014)	Satisfied
Calliper = 0.05	327	-3,484** (1,748)	Satisfied
Nearest neighbour (with replacement)			
Neighbour = 1	-	-	Not satisfied
Neighbour = 2	327	-3,930** (2,007)	Satisfied
Neighbour = 3	327	3,443* (1,867)	Satisfied
Kernel matching (with replacement)			
Bandwidth =0.01	327	-4,187** (2,070)	Satisfied
Bandwidth =0.02	327	-3,896**(1,957)	Satisfied
Bandwidth =0.05	327	-3,225* (1,694)	Satisfied

Note: significant levels are based on bootstrapped t-values (standard errors are reported in brackets).
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

[11] The study also estimated using variants of each of the estimators, and the results are consistent. Results are not report here for brevity.
[12] Because of the less number of farmers in the control group, matching was performed 'with replacement'. Thus, it was possible to maintain reasonably high observations in the region of common support for the different estimators.

4.5 Conclusions

Middlemen continue to play a major role in many value chains. Most theoretical and empirical work on middlemen highlights the positive role of intermediaries in facilitating trade by decreasing transaction costs related to search time and information. However, following the recent trends in food value chains toward quality and safety requirements and some theoretical (Hackett, 1992; Masters, 2008) and empirical work (e.g., Minten et al., 2010), the study hypothesized that middlemen as an institution might be ill-suited to deal with new challenges in the modern economy. To test this hypothesis, the study investigated the factors leading to the reliance on middlemen by smallholder farmers, and the impact of using this institution on farmers' income (and the implication on intensifying smallholders' commercialization). In this respect, the potato market in the Rift Valley region of Ethiopia provides rich evidence as the institution of middlemen is highly prevalent in potato marketing.

The results show that age, education, volume of production, number of livestock units, location (a proxy for access to market), and ethnic ties significantly affect farmers' decision to use (or not) the institution of middleman when selling potatoes. To estimate the economic impact of trading through middlemen, the study controlled for self-selection bias using the propensity score matching. The findings showed that the use of middlemen in the potato market is inefficient from the welfare perspective of smallholder potato farmers. Income per hectare from potato sales was lower by 39% for farmers who relied on middlemen compared to farmers who sold to direct buyers. Sensitivity analyses have shown that the results are plausible to make causal interpretations.

The study also investigated why smallholder potato farmers still use middlemen when in fact doing so may be economically inefficient. The explanation relates to ethnic ties, which result in lock-in and thus prevent smallholders from using other types of institutional arrangements. By analyzing the factors leading to farmers' reliance on the institution of middleman in the potato trade and the impact of such relationship on economic performance, this study contributes to the broader body of literature on the impact of social networks on the economic performance of smallholder farmers (Ali and Peerlings, 2011; Fafchamps, 2000; Fafchamps and Minten, 1999; Moore, 1997; Nooteboom, 2007). The study suggests that middlemen prevent the emergence of other forms of institutional arrangements, such as formal contracts

or preferred seller-buyer relationships, which could better intensify smallholders' commercialization in remunerative and quality oriented markets.

The study also provides relevant policy implications. First, it is apparent that the institution of middleman arises as an informal way of structuring exchange and economizing on transaction costs. However, this institution may also limit competition in trading relations. Similar to middlemen in the fishing industry in Mexico (Pedroza, 2013), middlemen in the potato sector appear to constitute a 'hidden population' as they choose to work unnoticed by the formal authorities. The problem with this type of trading relationships is the presence of considerable ambiguity about the nature of their activities (Feige, 1990), and the (potential) negative effect of this relationship on economic performance. Thus, a policy measure is suggested to closely monitor the activities of middlemen in their relationship with smallholders. One area of intervention could be through introducing a more transparent pricing system in the value chain. At the moment, farmers do not exactly know how the price they receive is determined by the actual buyers. Second, most of the middlemen are self-employed people with low opportunity cost of labor. Thus, this study suggests a policy measure not attempting to avoid this institution but rather providing assistance to help them perform their activities in a more transparent and responsible manner. Transparency in contractual relationships between farmers, middlemen, and traders can promote competition and improve smallholders' welfare. Third, the increasing demand for high quality and safety requirement of the modern market calls for a more integrated contractual relationship such as preferred buyer-seller or contract farming arrangements. In this regard, middlemen prevent the emergence of such institutional arrangements, for instance, by misinforming smallholder farmers through their social networks. Thus, educating farmers (for example, through development agents) about the potential benefits of integrated market chains is crucial to intensify smallholders' commercialization in high value markets.

Finally, the study notes some possible limitations, particularly, in relation to the cross-sectional nature of the data. The research is based on gross income. This assumes that the cost structure of individual farmers is similar. Although this seems plausible in the existing condition of the potato market and the relatively low opportunity cost of labor at the smallholders' level in the study area, the results could still be different if farmers selling to direct buyers incur additional costs (e.g. search costs), and the opportunity costs of labor for

these farmers are relatively high. The results of this study could still suffer from unobservable covariates. For instance, farmers' use of middlemen and profitability may be affected by entrepreneurship traits which the study only attempted to capture by using age and education level. Future research may also benefit from a quantitative analysis of the effect of middlemen on the income of potato traders.

Appendix 4.1 Sensitivity results of Rosenbaum bounds for gross income per hectare

Gamma	sig+	sig-	t-hat+	t-hat-	CI+	CI-
1	0	0	-4225	-4225	-5114	-3262
1.1	0	0	-4510	-3937	-5386	-2972
1.2	0	0	-4758	-3669	-5634	-2664
1.3	0	0	-4988	-3426	-5880	-2396
1.4	0	0	-5198	-3173	-6077	-2141
1.5	0	0	-5381	-2977	-6293	-1916
1.6	0	0	-5561	-2754	-6492	-1673
1.7	0	0	-5737	-2566	-6658	-1448
1.8	0	0	-5902	-2376	-6822	-1223
1.9	0	0	-6040	-2195	-6963	-1034
2	0	0	-6179	-2035	-7122	-808
2.1	0	0	-6324	-1880	-7264	-620
2.2	0	0.01	-6455	-1709	-7392	-440
2.3	0	0.01	-6577	-1566	-7528	-250
2.4	0	0.02	-6692	-1410	-7654	-88
2.5	0	0.03	-6800	-1261	-7754	81
2.6	0	0.05	-6895	-1132	-7857	252
2.7	0	0.07	-6992	-1002	-7964	428
2.8	0	0.11	-7087	-854	-8078	590
2.9	0	0.14	-7190	-718	-8203	724
3	0	0.19	-7278	-607	-8297	883

Note: gamma - log odds of differential assignment due to unobserved factors; sig+ - upper bound significance level; sig- - lower bound significance level; t-hat+ - upper bound Hodges Lehmann point estimate; t-hat- - lower bound Hodges-Lehmann point estimate; CI+ - upper bound confidence interval (a= .95); CI- - lower bound confidence interval (a= .95).

Chapter 5

Contract farming configuration: Smallholders' preferences for contract design attributes

This chapter is based on the article that has been published as 'Abebe, G.K., Bijman, J., Kemp, R., Omta, O. and Tsegaye, A., 2013. Contract farming configuration: Smallholders' preferences for contract design attributes. *Food Policy* 40, 14-24'.

5. Contract farming configuration: Smallholders' preferences for contract design attributes

5.1 Introduction

Participation in global markets calls for greater integration in agrifood value chains to respond to the quality and safety requirements of international customers. Contract farming (CF) has been claimed to have a positive impact on local economies by improving the welfare of rural households (e.g., Barrett et al., 2012; Bellemare, 2010; Bijman, 2008; Grosh, 1994; Reardon et al., 2009a; Singh, 2002). However, CF also remains a much debated institutional arrangement (e.g., Key and McBride, 2003; Key and Runsten, 1999; Oya, 2012; Singh, 2002). Discussion on CF mainly revolves around recurrent issues, such as the role of private-led CF schemes in addressing market failures (Grosh, 1994) and in reducing the risk of agribusiness firms with regard to production, land expropriation, and labor (Herath and Weersink, 2009), and emerging issues, such as agri-food globalization, private standards, and land grabbing (Oya, 2012). Analyses of CF often use a political economy perspective, an institutional economics perspective, or a combination of both.

In the political economy view, CF is seen from the lens of unequal power relations, conflict, and labor related issues (Little and Watts, 1994; Wilson, 1986).The main concern is that CF can lead farmers into problems such as loss of autonomy, increased production risk, and indebtedness (Little and Watts, 1994; Porter and PhillipsHoward, 1997; Rehber, 1998; Singh, 2002).

Conversely, the institutional economics view emphasizes the role of CF in addressing market failures (e.g., Barrett, 2008; Grosh, 1994; Key and Runsten, 1999; Kirsten and Sartorius, 2002; Minten et al., 2009; Sartorius and Kirsten, 2007). More specifically, this literature focuses on the micro-functioning of CF schemes, dealing with transaction costs resulting from uncertainty, risk, market imperfections, and coordination failures.

Empirical studies in developing countries provide varied analyses about participation and welfare effect of CF. Several authors found that participation improves farmers' income (e.g.,

Barrett et al., 2012; Bellemare, 2012; Warning and Key, 2002), although the extent to which participation contributes to the welfare of smallholders continues to be a methodological question (Barrett et al., 2012). Evidence is mixed, however, concerning inclusion. While Warning and Key (2002), in Senegal, Miyata et al. (2009) and Wang et al. (2011), in China, found no evidence of exclusion of smallholders from participation, others, such as Singh (2002), in India, Guo et al. (2005), in China, and (Key and Runsten, 1999), in Latin America, reported the opposite. The literature also documents several problems affecting CF performance: high default rate, biased terms, delayed payments, cheating, and lack of compensation for crop failure (Guo et al., 2005; Singh, 2002). Furthermore, Barrett et al. (2012) reported cases of high participation turnover due to lack of commitment to honor agreements by either party.

A general conclusion from the literature is that CF improves income. Even those who are critical of CF schemes generally agree that participation improves household income (Little, 1994; Singh, 2002). Indeed, farmers will only participate in CF if there is an expected gain in doing so (Bellemare, 2012). Likewise, firms will choose CF when the expected benefits from contracting exceed those of the alternatives, such as buying on a spot market or producing on proprietary farms.

One question the existing literature does not address is about farmers' preferences for particular contract terms and provisions. While the main motivation of smallholders to enter into CF is the resolution of market failure, a closer look at participation decisions may disclose how different contract provisions are evaluated. Eventually, smallholders' contract acceptance can be improved by better aligning contract terms and provisions with farmers' preferences (Minten et al., 2009).

This Chapter addresses the following research question:

RQ4: *Which contract attributes do motivate smallholders to participate in a contract farming scheme?*

This study argues that contract terms and conditions, hereafter called contract design attributes, can affect farmers' decisions to participate in CF by varyingly affecting their expected level of utility from participation. In theory, contracting parties choose a contract design that provides little incentive to opportunism. However, in practice, contracts are biased toward agribusiness firms and often expose smallholders to ex post risk (Singh, 2002), because firms choose contract design attributes that will offer them the highest payoffs without considering farmers' expected utility level (Barrett et al., 2012). Masakure and Henson (2005) noted that contracts involving smallholders are rarely governed by explicit performance and risk-sharing incentives. Hence, the likelihood that a contract design is attractive to smallholders remains uncertain. For the firm, this could lead to high transaction and coordination costs due to possible side-selling, default, and underinvestment (Delpierre, 2009; Miyata et al., 2009).

In reviewing the CF literature, the study noted several gaps. First, although many authors discussed the importance of contract design attributes, surprisingly little attention has been paid to measure the relative importance of these attributes directly from farmers' perspective. The study builds on Masakure and Henson (2005), who explicitly focused on ex ante aspects of smallholder' motivation toward CF. While these authors asked farmers about their motivation to enter into CF, the study goes a step further by using an experimental approach to elicit their preferences on contract design attributes. For example, while the authors reported oral contracts as the preferred contract form by the buyer firm, they did not investigate whether this option was also preferred by the farmers. Second, there is a general assumption in the literature that farmers are risk averse, and that their motivation to participate in CF is primarily to manage output price risks (Chavas and Holt, 1996; Michelson et al., 2011). Subsequently, agribusiness firms tend to design contracts with pre-fixed price, quantity, and quality specifications. However, contract design is a complex process involving many trade-offs (Bogetoft and Olesen, 2002), and farmers may have different risk preferences for the different markets in which they operate. Third, previous studies on CF heavily focused on the income and broader welfare effects, as well on individual-specific characteristics, as key determinants for participation. Yet, the effect of different contract design attributes on smallholders' contract choice has not received much attention.

The main objective of the present study is to explore the relative importance of different contract design attributes that could differentially affect the motivation of smallholders to participate in a CF scheme. Better information on farmers' preferences can be used by agribusiness firms to design better contracts as well as by policy makers in developing an enabling institutional environment.

The study fits the framework developed by Barrett et al. (2012), where participation decision is conceptualized as a sequence of four stages: firm choice of procurement location; firm contract offer; smallholder contract acceptance; and firm and smallholders' decisions to honor the contract. In this framework, the fourth stage (contract compliance) is the outcome of the preceding stages, which reflect the attractiveness of the contract offer and the likelihood of the offer being accepted by farmers. Hence, the study is, in effect, an attempt to understand the preferences of farmers toward a contract offer ex ante, and can be considered as a first order condition for causality studies such as Bellemare (2012) and Barrett et al. (2012).

To achieve this objective, the study combined a literature review to define contract design attributes, an analytical hierarchy process (AHP) method to identify the most important contract design attributes, and a discrete choice experiment (DCE) to elicit individual preferences. Choice-based approaches are relatively new to the CF literature.

The remainder of the chapter is organized as follows. Section 5.2 provides a literature review and the conceptual framework. Section 5.3 presents data and methods, followed by section 5.4, where it presents the empirical results and discussion. Finally, section 5.5 provides the conclusions.

5.2 Literature review and conceptual framework

The objectives of this literature review are to explore the factors leading to CF, understand agricultural contract functions and concepts, and identify contract design attributes that could motivate smallholders to participate in CF. The study does not aim to provide a full literature review of the determinants and the effects of CF; readers are advised to read the overview by

Little and Watts (1994), Kirsten and Sartorius (2002), Bijman (2008) or, more recently, Barrett et al. (2012).

5.2.1 Market imperfections and transaction costs – antecedents for participation in CF

Contracting between farmers and their buying firms can be conceptualized as a specific form of governance structure. According to transaction cost economics (TCE), governance structures are institutional arrangements that have evolved (or have been chosen) in order to prevent or reduce transaction costs (Williamson, 1979). Although the TCE literature usually emphasizes asset specificity as the main source of transaction cost, in agricultural transactions, uncertainty is the most common determinant of governance structure (Masten, 2000). Agricultural transactions involve high uncertainty because products are perishable and harvested seasonally. When farm products are delivered to the processing industry, transactions involve high coordination costs because of aligning production, harvesting, collection, and processing. In developing countries, which are often characterized by high market failures, smallholders are exposed to additional risk and uncertainty (Delgado, 1999; Key and Runsten, 1999; Poole et al., 1998; Poulton et al., 2010). Production risks are not only resulting from uncontrollable factors such as weather conditions, the quantity and quality of output is also affected by the environmental uncertainty related to failing input markets (e.g., unavailability of fertilizer at crucial moments in the growth cycle of the plant). In addition, farmers face price uncertainty due to high fluctuations in demand, and technological uncertainty due to insufficient assistance for using new crop varieties or inputs (Smale et al., 1994). By entering in a CF scheme, smallholders have the opportunity to engage in the production of a remunerative crop, a production that otherwise would entail high uncertainties that present prohibitive risks.

From the perspective of the agribusiness firm, CF can be an attractive governance structure as it allows reducing the transaction costs related to procurement risks. Particularly for companies processing agricultural products, uniform quality and consistency of supply is of crucial importance (Sartorius and Kirsten, 2007; Vermeulen et al., 2008). For preferred suppliers of fresh produce to supermarkets, CF schemes can reduce their risk of sourcing products that have the proper certificates, indicating the products have been produced under the strict quality requirements of the (foreign) retailer (Jaffe et al., 2011).

Transactions involving seed potatoes

The transaction this study has been analyzing is the production of seed potatoes by smallholder farmers and the sale of seed potatoes to a trading company. This trading company, in turn, sells seed potatoes to domestic and (mostly) foreign ware potato growers. The production of seed potatoes is more risky than most other crops, for several reasons. First, seed potato production requires intensive cultivation practices like selecting the appropriate planting date and harvesting date, frequency of tillage, fertilizer application at the right moment in plant growth cycle, frequency of fungicide application, and storage (Hirpa et al., 2012). There are several trade-offs in crop management practices. For instance, focusing too much on yield growth may not lead to proper tuber size (as demanded by the buyer). This is even more challenging as tuber size is not easy for farmers to observe on a daily basis. Second, seed potato production is costly as it requires large amount of planting material per unit of land (Batt, 2003). Third, potato is a seasonal product and rather perishable. This requires a timely coordination to minimize the loss of value during the process of harvesting, storage, distribution and marketing.

The complex nature of seed potato production may therefore expose smallholders to direct transaction costs, such as searching and selecting of the right quality seed and other inputs, and indirect transaction costs resulting from missing input markets or the failure to identify appropriate trading partners. In addition, seed potato production requires specific investment in human capital, due to the specificity of crop management practices. Thus, the high cost of seeds, the need for specific inputs, the special skills needed, and the limited market opportunities of the harvested product all call for an institutional arrangement that sufficiently reduces direct and indirect transaction costs, while maintaining the incentive structure for individual farmers. Such hybrid governance structure can be the CF scheme.

While TCE literature seeks to forecast or explain the incidence of particular governance structure (as the outcome of an economizing process), this study is more interested in the details of the contractual arrangement and how the different contract attributes can accommodate particular risks. The main functions of agricultural contracts include minimizing of coordination and transaction costs, providing incentives (including penalties), and sharing of risks (Bogetoft and Olesen, 2002; Grosh, 1994; Key and Runsten, 1999). To realize these functions, a contract design may incorporate several instruments, such as risk-

sharing mechanisms, incentive schemes, contract menus, repeated contracting and renegotiation options, and simplified and transparent contract terms (Bogetoft and Olesen, 2002).

In a CF scheme, the main contract design problem of the firm relate to the quality and price of the product; the sufficiency of supply; the necessary inputs; and the coordination of production, harvesting and delivery (Key and Runsten, 1999). Often the firm's solution to this problem is to define profit maximizing contract terms assuming that the farmer will accept and honor them. However, contract design is a multi-criteria decision problem involving trade-offs (Bogetoft and Olesen, 2002) and, hence, should also include the incentive considerations and risk-bearing capacities of smallholders (Lajili et al., 1997).

Table 5.1 shows the relationship between contract design concepts, functions, and attributes. While contract design attributes can be considered as factors that affect smallholders' motivation to participate in CF, they can also be conceptualized as instruments that are used by a firm to achieve coordination, motivation, and transaction cost minimization objectives.

Table 5.1 Contract design concepts, functions, and attributes

Contract design concepts	Contract functions	Contract design attributes
Coordination	Coordination of production, harvesting, and processing/marketing; allocation of risks	Form of contract; product quality specification, seed quality specification, quality control mechanism, place of quality inspection; input supply arrangement, technical assistance, transportation, and credit
Motivation	Provide proper incentives for effort and investment; reduce opportunism and renegotiation, allocation of value; continuity	Price option, form of contract, quantity, and contract duration; product quality specification, and quality control mechanism; specification of who bears what risk
Transaction costs	Reduce direct and indirect cost of contracting; increase transparency	Form of contract; product quality specification; sanctions; conflict resolution procedure

5.2.2 Conceptual framework

The conceptual framework explains how farmers choose CF to reduce uncertainty, and how different contract design attributes could varyingly affect their motivation to participate in CF. In order to understand smallholders' motivation toward CF, the study first proposes 12

contract design attributes that were adapted from Masakure and Henson (2005). Using a Principal Component Analysis (PCA), they reported 11 attributes that varyingly influenced smallholders' choice to participate in CF in the context of a high-value fresh produce exports. The study used a choice-based research design, which requires respondents to choose among alternatives rather than to rank or rate them (Chang et al., 2012). A choice task that involves more than six attributes is not recommended (Green and Srinivasan, 1990), as this tends to confuse respondents (Sawtooth Software, 2008). Thus, the study had to limit the contract design attributes to six. To do so, the study carried out a pilot study among 20 seed potato farmers, 60% of them had experience in CF. The results were analyzed using the Analytical Hierarchy Process (AHP) method. AHP has been used in several applications of multi-criteria decision making (Ghodsypour and O'brien, 1998), and evaluates a set of alternatives in a hierarchical structure.

Table 5.2 Pilot study results (n=20)

Source of uncertainty[a]	Contract design attributes	Mean score [b]
Output market uncertainty	Price option	**0.369**
	Form of contract	**0.359**
	Contract duration	0.149
	Contract quantity	0.123
Quality uncertainty	Seed quality specification	**0.479**
	Product quality specification	**0.217**
	Quality control mechanism	0.182
	Place of quality inspection	0.122
Input market uncertainty	Input supply arrangement	**0.361**
	Technical assistance	**0.269**
	Transportation arrangement	0.250
	Credit arrangement	0.121

[a] Based on Masakure and Henson (2005); [b] Figures in bold correspond to the attributes used in the DCE

Table 5.2 details the relative importance of different contract design attributes. The farmers evaluated every pair of contract design attributes using a pairwise comparison matrix (Sinuany-Stern et al., 2000). In the pairwise comparison, two contract design attributes from each of the three sources of uncertainty were shown on either side of a 9-point scale, where 1 shows both contract design attributes are equally important and 9 represents that one of the contract design attributes is extremely preferred over the other. Subsequently, farmers

evaluated a total of 18 judgments[13] (pairwise comparisons). The AHP uses the eigenvector method to yield priorities for criteria and for elements by criteria, and then synthesizes the priorities of the elements by criteria into composite measures to arrive at a set of ratings for the elements (Sinuany-Stern et al., 2000); the best alternative is the one with the highest rate.

Concerning output market uncertainty, farmers considered price option and form of contract more important than contract duration and quantity. As to quality uncertainty, seed and product quality specifications were more important than quality control mechanism and place of quality inspection. Regarding input market uncertainty, farmers considered input supply arrangement and technical assistance more important than transportation and credit arrangements. The six highest weighted contract design attributes (Table 5.2, mean scores in bold) are used in the conceptual framework; they will be discussed individually below.

Price option

Price volatility is one source of uncertainty that may affect smallholders' participation decision in CF. Different price options may entail different risks and rewards (Hueth and Ligon, 1999). Price option refers to the payment conditions farmers accept in exchange for delivering an agreed product quality and quantity. The common price options are fixed, variable, or formula (Bogetoft and Olesen, 2002; Miayata et al., 2009). For simplicity, the study focuses on fixed and variable price options.

If a contract specifies a fixed payment ex ante, farmers only bear the production risk while the firm takes all the market risk. By accepting a lower expected price, farmers, in effect, agree to pay a risk premium. Indeed, a fixed price option increases the firm's risk exposure. However, the firm can employ different risk management tools that are not available for farmers. Conversely, if farmers consider a fixed price option unattractive, the firm can use a variable price option. This strategy may reduce moral hazard problems, by making both parties residual claimants, but may increase farmers' price risk exposure (Wolf et al., 2001). Since this study is to be conducted with seed potato farmers, the variable price option is disaggregated into size-based and yield-based.

[13] The number of pairwise comparison is given by $n(n\text{-}1)/2$; where n is a matrix of contract design attributes in each of the three sources of uncertainty, which is $3[4(4-1)/2]$.

Obviously, there are trade-offs in choosing one price option over another. While choosing a fixed price option provides farmers insurance against downside price risks, this option would disfavor them when the ex post spot market price by far exceeds the price agreed in the contract. Based on evidence from several empirical studies (Minten et al., 2009; Miyata et al., 2009; Tripathi et al., 2005), farmers are expected to prefer a fixed price option over a variable one, ceteris paribus. Furthermore, seed potato production that targets a specific tuber size increases the intensity of crop management practices. Hence, farmers are expected to prefer the yield-based over the size-based price option, ceteris paribus.

Form of contract

Allocation of risks and rewards could be affected by the form of the contract, which can be written or oral (Barrett et al., 2012). A written contract specifies detailed roles and responsibilities, procedures for monitoring, and penalties for performance non-compliance (Poppo and Zenger, 2002). Although a written contract could provide better enforcement possibilities, it remains incomplete (Williamson, 1979). In an oral contract, reputation and repeated interactions are the main enforcement mechanisms (Wolf et al., 2001). Levin (2003) argues that oral contracts can substitute written contracts by promoting trust in the relationship, providing the incentive to pay promised compensation, and giving the parties the option to walk away.

Due to limited prior exposure to working with agribusiness firms, farmers are expected to prefer the coordination and motivation provisions of a contract to be specified in a written form over an oral form, ceteris paribus.

Seed quality specification

Seed quality uncertainty shows the systematic link between input and output markets; i.e., it implies that specific inputs are necessary to get definite output quality (Little and Watts, 1994; Scott, 1985). From the farmers' perspective, seed sourced from anonymous suppliers may lack quality and could expose them to production risk, such as yield, and price risk, due to poor output quality. CF can reduce seed quality uncertainty if the buyer firm is supplying seed as part of the contract. Seed quality specification becomes more important when output

quality is difficult to measure (Goodhue, 2011). By supplying seed of a known quality, a part of the quality risk will be reduced, both for farmers and the buyer firm.

From the above discussion, two seed quality specification options can be considered: seed sourced from the buyer firm or from another supplier. When seed is sourced from the buyer firm, quality (and supply) of the seed is assured, but farmers are bound to sell the output only to the buyer firm (Henson et al., 2005). Conversely, when seed is sourced from another supplier, the quality of the seed is not guaranteed because the other supplier may have an incentive to cheat. Moreover, the market for good quality seed may not be accessible for farmers.

The trade-off for the farmers would be whether to use buyer firm supplied seed that could be overpriced because the firm may have monopoly power in supplying the seed but reduces the risk of low quality seed, or to buy seed from other suppliers, at a lower price but take the risk of low quality seed. Because the implication of seed quality for both production and price risk is high, farmers are expected to prefer the buyer firm despite concerns for higher seed costs, ceteris paribus.

Product quality specification

Quality uncertainty is one source of risk in agricultural transactions (Wolf et al., 2001). The desire for high (specific) quality attributes increases the firm's willingness to engage in CF (Goodhue, 2011; Henson et al., 2005). Likewise, searching for buyers and getting to know their quality requirements is difficult in an imperfect market environment. Hence, CF is expected to reduce farmers' quality uncertainty because the quality demand of the buyer firm will be known ex ante. Accordingly, two contract options can be considered: minimum quality for all deliveries or provisions for variable quality.

Minimum quality for all deliveries refers to cases where farmers receive the same payment per unit by virtue of meeting a pre-specified minimum quality level. Consequently, farmers assume the risk of product rejection without receiving a premium for an above average quality. This option entails a low price risk related to an imperfect quality measurement by the buyer, as there will be a single standard to measure quality. A firm that targets a single channel may find this option appropriate. In contrast, a firm having differentiated markets

may accept or even prefer different quality levels. Because payment depends on performance, this arrangement may stimulate farmers to deliver a high quality product. However, this option requires several quality measurement criteria. Consequently, the cost of measuring quality is expected to be high and may expose farmers to additional price risk (Hueth and Ligon, 1999). For instance, a farmer who has delivered a high quality product, after investing in quality improvements, could still receive a low price due to a measurement error by the buyer firm.

Generally, the choice for farmers is between a fixed quality option, which offers little incentive for improving quality and holds the risk of complete rejection, and a variable quality option, which may expose them to downside price risk because of a quality measurement error. However, in a CF scheme, the risk of incorrectly measuring quality tends to be more frequent than the risk of complete rejection, and thus farmers are expected to prefer a fixed quality contract over a variable one, ceteris paribus.

Input supply arrangement

In an imperfect input market, farmers may have limited access to specialized inputs. In order to access such inputs, farmers may consider to participate in CF. This may give the firm a monopoly power over the provision of specialized inputs and a monopsony power in the product market (Key and Runsten, 1999). To avoid becoming fully dependent on the buyer firm, farmers may opt to source key inputs from a third party. However, provision by public agencies is often less efficient and effective (Dorward et al., 2004), which could endanger the CF relation between the buyer firm and smallholders.

Input supply, therefore, could be arranged by the buyer firm, the government, or an NGO. When inputs are supplied by the buyer firm, the firm has the advantage of controlling the quality of inputs and key crop management practices (Wolf et al., 2001). Alternatively, when inputs are supplied by the government or by an NGO, the firm can allocate its resources to other activities and can avoid the risk of credit default and collection costs. The pros and cons of this type of public-private partnerships are increasingly discussed in the literature (Boselie et al., 2003; Harou and Walker, 2010, cited in Barrett et al., 2012; Poulton and Macartney, 2012).

Given the trade-off in each arrangement, farmers are expected to prefer the buyer firm to supply the inputs despite concerns that the firm could overcharge for these inputs, ceteris paribus.

Technical assistance

Similar to the input supply arrangement, the need to access information (on technology, timing, and quality, see Key and Runsten, 1999) may motivate farmers toward CF. Access to new production techniques not only helps farmers to improve production and market performance of the contracted crop, it can also have a positive spillover effect on other crops (Masakure and Henson, 2005; Minten et al., 2009). Technical assistance can be arranged in different ways. The buyer firm could provide all the required technical assistance. While this type of arrangement may allow farmers to get technical assistance and research-based information, the buyer firm could overcharge farmers for this service. Alternatively, government or NGO extension agents could provide technical assistance. However, they may be less effective in providing contract-specific technical assistance.

Given the above considerations, farmers are expected to prefer the buyer firm to provide technical assistance despite concerns that the firm may overprice the services, ceteris paribus.

Table 5.3 Summary of the conceptual framework

Categories	Contract attributes		Attribute levels
Output market uncertainty	Price option	1	A fixed price, for all deliveries
		2	Variable price, depending on yield
		3	Variable price, depending on tuber size
	Form of contract	1	No written contract
		2	Written contract
Quality uncertainty	Product quality specification	1	Minimum quality requirements for all deliveries
		2	Variable quality is accepted, with variable price
	Seed quality specification	1	Seed supplied by buyer firm
		2	Seed purchased from another supplier
Input market uncertainty	Input supply arrangement	1	Provision of inputs by the buyer firm
		2	Provision of inputs by the government
		3	Provision of inputs by an NGO
	Technical assistance	1	Provision of technical assistance by the buyer firm
		2	Provision of technical assistance by the government
		3	Provision of technical assistance by an NGO

In sum, the conceptual framework highlights the trade-offs farmers encounter in evaluating different sets of contract design attributes. Table 5.3 summarizes the conceptual framework discussed before.

5.3 Data and methods

5.3.1 Study context and description of the data

Ethiopia is endowed with good agro-ecological zones (cool highlands) for the production of relatively disease free and high quality seed potatoes. Although some improved varieties exist, which were released by the state research institutes, the uptake for such varieties is very low (Hirpa et al., 2012), because adaptation of these varieties to local conditions is low and seed supply systems are poorly developed.

Following the 2005 Agriculture Development Led Industrialization policy, the country has attracted many foreign firms. As of 2009, the government had either granted or promised to grant around three million hectares of land to foreign investors (Weissleder, 2009). As this practice has been scrutinized by activists and international NGOs (Li, 2011; Oya, 2012), CF has become increasingly attractive for foreign firms. Although the government considers CF as a suitable policy instrument to integrate farmers into agricultural value chains (Minot, 2011), participation continues to be low, with many problems of non-compliance and side-selling (Getaneh and Bekabil, 2008).

In 2006, a foreign-owned agribusiness firm started a CF scheme to produce seed potatoes for the export market. West Shewa Zone, one of the areas selected for this purpose, has a population of over two million, with an average family size of 4.8 and an average farm size of 1.4 ha (Deininger, 2003). Farmers in the area grow several crops in addition to potatoes. However, participation to the CF scheme was limited to farmers who had agricultural land along the irrigation canal, which was built by the local government. The foreign-owned firm provided different seed varieties, which were all imported, and other inputs to the contracted farmers. Furthermore, the firm assigned personnel to provide technical assistance and to monitor farm management practices.

The experiment was conducted between September and November 2011. Half of the respondents were purposely selected because of their experience in growing seed potatoes under a CF scheme. But the other half were randomly selected from the land ownership register. From those who did not participate before, 82% of them indicated their intention to participate in the next season. This helped us to attain the maximum level of realism to conduct the experiment.

The questionnaire contained three parts: open questions, socio-economic data, and the DCE. The open questions were meant to understand respondents' perception about CF. Accordingly, 98% of farmers responded that participation could bring some benefits, such as improved income, access to key inputs and technical assistance. However, 68% of participated and 38% of non-participated respondents expressed their concerns about CF, which included possible disagreement on contract terms, lack of trust in the relationship, and low contract price.

Regarding the socio-economic variables, it was expected that some individual and household level characteristics affect the probability of choice. Therefore, the study collected data on age, education level, sex, farm size, experience in potato farming and contract farming, access to irrigation, and distance from the main road (Table 5.4).

5.3.2 Discrete choice experiments

Choice experiments are based on the Lancaster's (1966) theory of consumer choice, where individuals derive utility from the different characteristics a good possesses, and McFadden's (1974) random utility theory, providing the econometric rationale of choice experiments. Following Lancaster (1966), attributes have been defined as characteristics of a good. However, recent studies have extended this concept to include aspects of policy design (Colombo et al., 2005), agro-environmental scheme design (Ruto and Garrod, 2009), community forestry design (Gelo and Koch, 2012), and land use management contract design (Tesfaye and Brouwer, 2012).

Discrete choices experiments (DCE) are used when a choice problem involves two or more discrete alternatives. Among the discrete choice models, logit is the most widely used model (Train, 2003). In this model, the random term is assumed to be independently and identically

distributed as type 1 extreme value distribution; i.e., the model takes the assumption that unobserved factors are uncorrelated over alternatives and have the same variance for all alternatives. In this study, DCE is used to construct alternatives that are defined in terms of contract design attributes and the levels these attributes could take.

5.3.3 Empirical model specification

The model developed in this study considers the contract design attributes (levels) shown in Table 5.3, which are assumed to deliver a certain level of utility to the potato farmers when participating in a CF scheme.

While the multinomial logit model is the widely used functional form in DCE, it does not accommodate preference heterogeneity within choice data and does not allow each respondent to respond to multiple choice sets (Ben-Akiva and Lerman, 1985; McFadden, 1974). A conditional logit model is appropriate when the choice among alternatives is modeled as a function of the characteristics of the alternatives rather than the characteristics of the individual making the choice. This makes the conditional logit model appropriate for estimating behavioral models.

The model specification follows Train (2003). In a sample consisting of *N* respondents with choice of *J* unordered alternatives on *T* choice tasks, the indirect utility that an individual farmer n drives from choosing alternative *j* on a choice task t from a finite set of *J* alternatives is given by

$$V_{njt} = \alpha_{jn} + \gamma_j z_n + \beta_n x_{njt} + \varepsilon_{njt} \quad (1)$$

where V_{njt} stands for the value (utility) of alternative *j* to individual *n* on choice task *t*, α_{jn} is the alternative-specific intercept, γ_j captures preference heterogeneity related to individual-specific characteristics, z_n is a vector of individual-specific variables for individual *n*, β_n captures systematic preference heterogeneity related to contract design attributes, x_{njt} is a matrix of contract design attributes specific to alternative *j*, and ε_{njt} is a matrix of a random term to account for the aspects of utility that the researcher does not observe.

Eq. (1) presents a general model that allows estimating alternative-specific effects (Gelo and Koch, 2011). First, the study employs a pure conditional logit model by restricting $\gamma_j = \gamma$ and $\alpha_{jn} = \alpha$ to model individual choices solely as a function of the characteristics of the alternatives. That is, assuming that $\beta_n = \beta$ and the error term is independently and identically distributed as type 1 extreme value and independent across alternatives, the logit choice probabilities can be derived by the following conditional logit model

$$P_{nit} = \frac{\exp(\beta x_{nit} + \alpha + \gamma h_n)}{\sum_{j=1}^{J} \exp(\beta x_{njt} + \alpha + \gamma h_n)} \quad (2)$$

where P_{nit} be the probability of individual n choosing alternative *i* on choice task *t* among *J* alternatives. In the conditional logit model (Eq. 2), the explanatory variables *x* assume different values in each alternative at each choice set. However, the impact of a unit of *x* is usually assumed to be constant across alternatives, giving only a single coefficient estimate for each *x* variable. Hence, the impact of a variable on the choice probabilities derives from the difference in the value of the characteristics across alternatives.

Second, the study relaxes the assumption and includes socio-economic factors; that is, the conditional logit model given in Eq. (3) separates explanatory variables into alternative-specific attributes of the choices, such as contract design attributes, and characteristics of the individual, such as age, sex, and education. This implies that the effect of individual-specific variables would be different for each alternative as indicated in Eq. (1). Thus, the alternative-specific conditional logit model probability is given by

$$P_{nit} = \frac{\exp(\beta_n x_{nit} + \alpha_{in} + \gamma_j z_n)}{\sum_{j=1}^{J} \exp(\beta_n X_{njt} + \alpha_{jn} + \gamma_j z_n)} \quad (3)$$

5.3.4 Experimental Design

DCE are used in this study to estimate the effect of different contract design attributes on the attractiveness of a contract. How well a discrete choice experiment performs partly depends on the options used in the choice experiment, and how the options are grouped into choice sets (Street et al., 2005). The AHP results (Table 5.2) provided a narrow range of contract design attributes and levels that the study then used to create choice sets using the Sawtooth

Software. The study tested the experimentally generated questionnaire for the clarity of choice sets. The final questionnaire consisted of three versions, which vary in the order and type of choice sets. Each respondent was randomly assigned to one of the three versions to make sure that the order of the choice sets does not affect respondents' preferences and to get more variation in the preferred choices.

Regarding the sample selection, the strategy was to include all the 72 farmers that already had a contract and the same number from the pool of non-contracted farmers. For the latter, 120 farmers were randomly selected from the land ownership register and continued the experiment until 72 farmers. Thus, a total of 144 respondents were selected, and each respondent was given 15 experimentally generated choice tasks, each contained two cards. Each card was described by one of the levels of the six contract design attributes. Hence, respondents were asked to evaluate their preferred set of contract design attributes in 15 different choice tasks, making it a panel of 2160 choice tasks and 4320 observations. The alternatives were constructed in a way that respondents had to make trade-offs to avoid any dominant choice tasks, in which one alternative is strictly superior to the other. During the experiment, the principal investigator explained respondents about each choice task before moving to the next task to ensure that they understood the trade-offs between profiles.

Scanning through Table 5.4, the descriptive statistics for participated and non-participated farmers are similar with the exception of access to irrigation. This is not surprising as the firm contracted with farmers that can produce seed potatoes during the off-rainy season.

Table 5.4. Household and individual characteristics of sample farmers

	Participated before (n=72)		Not participated before (n=72)	
Variables	Mean	Std. dev.	Mean	Std. dev.
Age (year)	39.7	14.3	39.2	11.9
Education (school year)	5.9	3.8	5.9	3.2
Experience in agriculture (year)	18.3	12.3	18.6	11.3
Farm size (ha)	2.9	2.4	2.4	2.2
Distance from farm to main road (km)	2.7	1.9	2.3	1.3
Respondent being male (%)	81.9		94	
Intention to participate in the next season (% yes)	80.6		82	
Access to irrigation (% yes)	100		29	

5.4 Results and discussion

Table 5.5 presents the estimated utility function parameters of the conditional logit model (clogit) and the alternative-specific conditional logit (asclogit) model.

Table 5.5 Estimations of the clogit and asclogit models

Variable[a]	clogit		asclogit	
	Coef. (std. err.)	Odds ratio	Coef. (std. err.)	Odds ratio
Oral contract	-3.01***	0.05	-2.15***	0.12
(Written contract)	(0.16)		(0.14)	
Minimum quality for all deliveries	-0.87***	0.42	-0.64***	0.53
(Variable quality specification)	(0.13)		(0.09)	
Seed from buyer	1.62***	5.06	1.02***	2.77
(Seed from other supplier)	(0.12)		(0.08)	
Fixed price	-0.29***	0.75	-0.33***	0.72
(Size-based price)	(0.11)		(0.10)	
Variable price (yield-based)	0.28***	1.32	0.57***	1.77
(Size-based variable price)	(0.15)		(0.14)	
Inputs by buyer	1.16***	3.18	0.89***	2.44
(Inputs by an NGO)	(0.11)		(0.12)	
Inputs by the government	0.04	1.04	0.06	1.06
(Inputs by an NGO)	(0.12)		(0.11)	
Technical assistance by the buyer	0.84***	2.32	0.61***	1.85
(Technical assistance by an NGO)	(0.10)		(0.10)	
Technical assistance by the government	0.19*	1.20	0.20**	1.22
(Technical assistance by an NGO)	(0.10)		(0.09)	
Sex			-0.06	
			(0.20)	
Age (ln)	-		-0.28	
			(0.33)	
Farm size (ln)	-		-0.12	
			(0.09)	
Experience in agriculture (ln)	-		0.02	
			(0.17)	
Education	-		-0.02	
			(0.06)	
Prior experience in CF	-		0.06	
			(0.14)	
Access to irrigation			0.07	
			(0.13)	
Distance from the main road in km	-		-0.02	
			(0.04)	
Constant	-		0.87	
			(0.94)	
Respondents	144		144	
Observations	4320		4320	
Log likelihood	-1718.89		-833.51	

* P<0.1; ** P<0.05; *** P<0.01; (robust) standard errors are given in parentheses; VIF, uncentered, 1.75. [a] Note: variables in brackets are the base alternatives. A variance estimator was applied to allow intragroup correlation (Baum et al., 2011).

5.4.1 Estimations of the conditional logit model

Referring to Table 5.5, with the exception of price option and product quality specification, all the other variables showed expected signs. With regard to contract form, the probability that farmers choose the base alternative written contract is 95%; that is, if a firm attempts to switch from a written contract to an oral contract, the odds of being chosen by farmers is only 5%, ceteris paribus. As to the input supply and technical assistance, the buyer firm is more likely to be chosen than the base alternative NGO; other things being equal, if a contract specifies input supply and technical assistance from the buyer firm, the odds of being chosen by farmers is 3.2 and 2.3 times higher than the base alternative NGO, in that order. In addition, the probability that farmers choose technical assistance by government agents is 55% compared to the base alternative NGO. Similarly, seed sourced from the buyer firm is 5 times more preferred than seed sourced from elsewhere, ceteris paribus. On the other hand, a fixed quality specification is less likely to be chosen than a variable quality specification. Thus, if the firm opts for a fixed quality specification, the odds of being chosen by the farmers will be 25% less than the odds of farmers choosing the base alternative size-based price option. However, the probability that farmers choose a yield-based price option is 57%, compared to the alternative size-based price option; that is, if a firm switches its pricing strategy from a size-based to a yield-based one, the odds of choosing the latter is 32% higher than the odds of choosing the former. The relatively higher preference toward the yield-based price option over the size-based was expected due to the high rejection risk in the latter.

5.4.2. Comparing estimations of the clogit model and asclogit model

Table 5.5 also provides a comparison of parameter estimation based on the conditional logit model and the alternative specific conditional model. In general, the sign and significant level of the choice-specific variables are the same in both models. However, in the alternative specific conditional logit model (1) the significance level of technical assistance by the government has increased; (2) the odds of choosing oral contract, fixed quality specification, and yield-based price option have all increased; and (3) the odds of choosing seed source, inputs, and technical assistance from the buyer firm have all decreased. Overall, the log likelihood has improved. This is expected as the inclusion of individual specific-variables is likely to improve the estimations of the conditional logit model (Train, 2003). However, the coefficients of the individual-specific variables were not statistically significant, implying

that the individual-specific variables included in the model did not systematically affect the probability of choice.[14]

5.2.1 Discussion

Smallholders producing seed potatoes in Ethiopia prefer a variable price contract. This result seems to contradict the common assumption that smallholders in developing countries are risk averse (Fafchamps, 1992), as well as the empirical findings of Miyata et al. (2009), Minten et al. (2009), Tripathi et al. (2005), and Bielza et al. (2007). The findings suggest that a pricing strategy contingent on certain performance criteria is more preferred than a fixed price. The results correspond to the findings of Wang et al. (2011) who reported smallholders' preference for a floating price.

Inconsistency of findings across cases may suggest that motivational differences vary depending on institutional settings. In the study area, a formula price was used by the firm, which was based on the price of ware potatoes at the nearby local market and the yield and size of seed potatoes. However, failure to meet the specified tuber size entails a significant loss for farmers; they receive only 25% of the price for ware potatoes at the local market.

There are several reasons why risk averse farmers may still opt for a variable price. First, farmers are suspicious that fixed prices will also be low prices. Thus, farmers appear to perceive that contracts not only hold low prices because of the 'insurance premium' they pay to the buyer, but also lead to underpayment because once farmer are locked into the contract the buyer can take advantage of the asymmetric power relationship. Second, farmers seem to believe that they can outperform fellow farmers. As principal investigator in the experiment, the first author observed that farmers were optimistic about their chances of meeting the quality requirements set by the buyer firm. This suggests that the fixed price option may penalize farmers who have entrepreneurial skills (as has been argued by Rehber, 1998). Third, earlier studies have documented trends of escalating food prices in Ethiopia (Alem and Söderbom, 2012), and have shown that the agricultural commodity market is characterized by speculative behavior (Tadesse and Guttormsen, 2010). It was also learned from farmers that

[14] The study re-estimated the asclogit model with only 'irrigation' and with only 'experience in agriculture', together with the contract design attributes; nonetheless, the model yielded no significant difference from the results reported in Table 5. This implies that access to irrigation and experience in agriculture did not have influence on the choice of contract design attributes.

the price of potatoes had been on the rise, which could be another factor in their decision toward a variable price.

Farmers' preference for a written contract could have at least two explanations. First, in a thin market environment, farmers need a guaranteed market for their product before they actually invest in production (Kirsten and Sartorius, 2002). A written contract could better serve this purpose than an oral contract as the former details the coordination and motivation aspects of a contract ex ante which could be used to resolve conflicts ex post. Second, a trust-based relationship is established primarily through repeated transactions (Fafchamps and Minten, 1999). Since agribusiness firms generally work in areas where they have not previously been operating, local farmers may not trust them (Guo et al., 2005; Singh, 2002). As a result, farmers may seek all contract provisions to be specified in a written form. Consistent with the result, Harou and Walker (2010, cited in Barrett et al., 2012) reported Ghanaian farmers' regret for accepting oral contracts from agribusiness firms. In the study area, the agribusiness firm used a written contract.

The preference for seed supplied by the buyer firm is also consistent with the risk averse attitude of farmers in the input market; i.e., the buyer firm is considered more reliable than any other source. This was expected as seed quality has a substantial effect on yield and price risk (Scott, 1984). Being the residual claimant of the contract, the firm has an incentive to supply good quality seeds. Furthermore, seed sourced from the buyer firm can facilitate risk sharing when producing a crop with specific attributes. All contracted farmers in the study area used firm-supplied seed.

The results on product quality specification show that farmers generally prefer a variable quality scheme rather than a fixed one. This implies farmers' willingness to accept a price risk that is due to a possible quality measurement problem. This result could at least relate to two factors. First, although the pricing scale adopted could still penalize them, a variable quality specification contract appears to be understood by farmers as a way to avoid the major risk that not all produce will be purchased. Second, as discussed above, farmers seem to believe that they can deliver an above average quality product. The implication for agribusiness firms is that a differentiation marketing strategy may be necessary to induce contracted farmers to deliver a high quality product. The practice in the study area was mixed; while the agribusiness firm used a fixed size-based output quality specification, the

yield-based one was variable. This practice seems to confirm the first point. During the experiment, it was learned from farmers about the difficulty of managing tuber size, which was also the main source of conflict between the farmers and the agribusiness firm. While the firm put a severe penalty for growing oversized potatoes, farmers preferred to sell the oversized seed potatoes in the alternative market as consumption (ware) potatoes because the price they could receive by selling in this market was much higher than what they would receive from the firm, which was only 25% of the local price. In contrast, when the farmers produced seed potatoes within the acceptable size range, they had a strong incentive to sell to the firm as the price they could receive from the firm was much higher than what they could get by selling in the local market.

With regard to input supply arrangement, the result confirms the risk averse attitude of farmers in the input market. This finding is in line with most of the literature, which concludes that input markets in developing countries are missing or imperfect (Fafchamps, 1992; Key and Runsten, 1999). Although public sector intervention is justified when markets fail, it is often ineffective due to unreliable delivery schemes and political interferences (Dorward et al., 2004; Poulton and Macartney, 2012). Moreover, growing non-traditional crops, such as tomato, seed potatoes, and other vegetables, uses large amounts of pesticides and fertilizer compared to traditional and staple crops (Singh, 2002). Hence, it could be convenient and efficient for smallholders to receive inputs from the buyer firm. In the study area, contracted farmers used firm-supplied inputs.

Similar to the input supply arrangement, farmers prefer the buyer firm over the state or NGOs in receiving technical assistance. This result was expected as private firms are generally considered more trustful and effective than public agencies in delivering timely extension services (Bellemare, 2010; Umali-Deininger, 1997). However, when the buyer firm is unable to offer technical assistance, farmers prefer government agencies over NGOs. This result shows an apparent tension between farmers' preferences and NGOs practices. The focus of NGOs is often on resource-poor households in addressing technology gaps left by the state (Farrington, 1993; 1995; Umali-Deininger, 1997). Furthermore, the work of NGOs often lacks consistency due to the multiple roles they play: partly responding to government failure, partly addressing market failure, and partly engaging in advocacy (Bebbington, 1996). As a result, smallholders may not consider NGOs as a reliable source of technical support in CF schemes. In the study area, smallholders have had experiences with several NGOs.

In general, farmers' choice of contract design attributes appears to be in line with the predictions of the transaction costs economics theory. Thus, farmers' choice of written contract over oral form, variable over fixed quality specification, and firm-supplied seed, inputs, and technical assistance over other sources of supply are all motivated by transactional risks related to uncertainty about buyer behavior, price risks, and missing markets. Likewise, farmers' choice of variable price over fixed price is related to the incentive regime.

Regarding the reliability of the estimations in Table 5, the uncentered vif test result shows 1.75 on average, implying no concern of multicollinearity. Also, the likelihood ratio test for the asclogit model shows no significance difference between the restricted model, with only contract design attributes, and the unconstrained model, with all the variables.[15]

5.5 Conclusions

Contract farming (CF) is becoming increasingly important in developing countries, partly because of domestic and foreign supermarkets requiring sophisticated value chains, partly because of the growing use of quality certificates and corporate social responsibility guarantees by downstream customers (Henson et al., 2005; Swinnen and Maertens, 2007). Recent discussions in the general CF literature mainly focus on smallholders' participation, contractual relations, and on how to measure the welfare impact of CF. With the objective of providing insights that can help to improve existing and future CF schemes, this study has explored smallholders' motivation for participation. The study hypothesized that farmers' motivation to participate in CF largely depends on the nature of the contract design attributes. The study tested this hypothesis by applying the DCE method, which followed a literature review and an AHP approach.

[15] Hausman McFadden test for the independence of irrelevant of alternatives (IIA) assumption is not possible in our study as each respondent had to face two mutually exclusive alternatives (e.g., fixed versus variable price, written versus no written contract, etc.). To test the IIA assumption, at least three alternatives are needed to test that the inclusion of a third alternative should not change the odds ratio of the other pairs of choices. One possibility was to include a no-choice option in the design. However, this did not seem realistic in our study as it provides no information on the impact of attributes on a choice set (Enneking *et al.*, 2007), and the tendency to choose the no-option is highly likely (Dhar, 1997).

The study shows that smallholders are generally positive about the prospect of CF to improve their livelihood, although the majority of them suspect contracts to favor agribusiness firms. In terms of motivation, this study shows that farmers' willingness to participate in CF increases if a contract design has the following attributes: a written form; inputs, technical assistance, and seed supplied by the buyer firm; and variable output quality and variable price options.

The study provides several contributions to the literature. First, the study shows that input market uncertainty is more important than output market uncertainty in smallholders' decision to participate in CF. In the input market, farmers consider CF as a mechanism of risk-sharing to reduce input supply and seed quality uncertainty. In the output market, farmers appear to be worried about the risk of underpayment by the firm once they are locked into a fixed-price contract. They tend to prevent this type of risk by opting for a variable quality specification and a variable output price. The significance of this result for CF schemes includes the following. From the behavior of smallholders in the output market, it can be concluded that fear of underpayment by the firm as well as factors outside of contractual relations such as institutional factors (e.g., rising food prices) and individual factors (e.g., entrepreneurial attitude of farmers) are most important. These factors, as a result, tend to discourage farmers from participation because CF limits smallholders' freedom to make autonomous decisions. Conversely, in the input market, smallholders seem to have been constrained by several problems, such as the unavailability of (quality) inputs, the lack of information on where to get and how to use them, and the lack of access to credit for buying these inputs. The conditions in the input market, therefore, tend to encourage farmers toward participation in CF. Furthermore, the findings imply that the attractiveness of a CF scheme partly depends on the strength of the institutional environment in solving input market constraints, and partly on the willingness of agribusiness firms to choose a pricing strategy based on variable prices.

Second, the study provides a new dimension of analyzing farmers' decision to participate in CF using a multi-category discrete choice model, where the choice of a contract is modeled as (1) a set of different contract design attributes, and (2) a combination of contract design attributes and individual-specific characteristics. Parameter estimates of the (alternative-specific) conditional logit model show that contract choice is largely determined by the characteristics of the choice sets rather than the characteristics of the farmer making the

choice. This implies that heterogeneity in a contract design may not be necessary in a CF scheme.

Third, unlike most studies on CF, which have a development economics or political economy perspective, the study takes a managerial perspective. The study shows the applicability of DCE models to investigate the attractiveness of different contract design attributes in CF relations. Knowledge on the preferences of farmers for participation could help agribusiness firms to design better contracts that would minimize the problem of side-selling, contract non-compliance, and low levels of participation. The findings suggest that an optimal contract can be designed through balancing the risk averseness of farmers in the input and output market and entrepreneurial desire of farmers in the output market.

The findings have two policy implications. First, smallholders have shown strong motivation to receive technical assistance and key agricultural inputs from agribusiness firms. Hence, to promote smallholder participation in CF and global value chains, public agencies should support agribusiness firms that engage in CF, for instance, by establishing infrastructure, facilitating access to credit, and providing other investment incentives. This finding also contributes to the discussion on public-private partnership, which emphasizes how institutional arrangements between public and private sector actors can best be aligned to appropriately allocate resources for development projects (Hodge and Greve, 2009; Poulton and Macartney, 2012). Second, the risk averse attitude of smallholders in the input market calls for institutional interventions to reduce these risks. One intervention area could be strengthening of collective action, such as producer organizations, to supply key agricultural inputs to smallholders. This type of intervention may also induce agribusiness firms to offer more competitive contracts to smallholders.

Finally, the study raises several issues that deserve further research. First, the study found that smallholders are generally risk averse. It would be interesting to know if farmers change their risk attitude in different institutional settings and crops. Second, it may be relevant to study the perception of agribusiness firms toward contract design attributes that smallholders considered more important. Third, it may be important to further explore the applicability of DCE models in CF schemes. Fourth, although the results are robust regarding smallholders' choices toward contract design attributes, there could be some bias in the estimates due to a potential problem of endogeneity. For instance, the study attempted to capture smallholders'

entrepreneurial attitude using the variable ‘experience in agriculture’. However, this may be a poor proxy, and further research may select other variables that could better measure entrepreneurship traits. Measuring entrepreneurial attitude is a common problem in the CF literature (see Barrett et al., 2012; Bellemare, 2012). Future research may also focus on contract schemes used for potatoes delivered to the wet market, the processing industry, and fast food restaurants, because production and transaction characteristics may differ from those of seed potatoes.

Chapter 6

Discussion and conclusions

6. Discussion and conclusions

This chapter discusses the main findings and provides the main conclusions. Section 6.1 provides brief answers to the research questions raised in chapter one. General discussion and conclusions will be presented in section 6.2. Section 6.3 discusses the contribution of the thesis to the literature, followed by the practical implications in section 6.4. Finally, section 6.5 outlines directions for further research.

6.1 Conclusions

Smallholders have constraints to improve quality and access high value markets because of several factors such as high transactional risks associated to the nature of the product (e.g., perishability, bulkiness, etc.), the market conditions (asymmetric information or power relation), and the institutional environment (e.g., lack of appropriate agricultural technologies, information, technical assistance, etc.). Within the framework of Co-innovation for Quality in African Food Chains (CoQA), the aim of this thesis has been to gain insights into the factors affecting smallholders to improve quality and market access by analyzing their relationship with upstream and downstream actors and thus to generate information relevant for the development of sustainable value chains in the potato sector. More specifically, the thesis has aimed to address:

- product or technology related quality alignment problems by analyzing the interactions between Ethiopian smallholder farmers and their upstream actors; and
- value chain related quality alignment problems by analyzing interactions between farmers and downstream actors (seller-buyer relationships).

The main focus of the first part of the study has been to examine the factors affecting quality alignment related to product quality (e.g., product development and variety choice) and the relationships between farmers and downstream actors. This type of analysis is important to understand the knowledge/information gap regarding the quality characteristics of potatoes demanded by farmers and downstream actors, and the institutional arrangements used to

govern contractual relations. Thus, the first part of the present study has addressed the following research question.

RQ1: *How do farmer and trader preferences for specific quality attributes and coordination mechanisms in farmer-trader relationships affect the alignment of quality in the Ethiopian potato value chain?*

This research question has been answered through two separate but related surveys.

In the initial survey, seven different potato varieties have been identified in a pilot study. Of these seven varieties, three are improved varieties (IVs) and four are traditional or local varieties (LVs). Based on a literature review and the pilot study, the main quality attributes of potatoes have been categorized into production-related (yield, disease resistance, maturity period, intensity of crop management, and drought tolerance) and market-related (stew quality, cooking quality, tuber size, and tuber color). Then the seven potato varieties were presented to farmers to evaluate these varieties regarding the distinguished production- and market-related quality attributes. Farmer-based evaluation of the different varieties showed that these varieties differ in terms of production- and market-related quality characteristics. Furthermore, no one variety has superior quality in both production- and market-related quality attributes. This means that farmers' decision to grow one variety over the other involves trade-offs. The study showed that farmers evaluated the IVs to have lower market-related quality attributes compared to the LVs, while they evaluated the IVs to have better production-related quality attributes compared to the LVs, particularly in yield and disease resistance. As farmers continue to grow LVs, the study concludes that there is a mismatch or misalignment between the focus of the research institutes, mainly on production-related quality attributes, and the preferences of the farmers, putting more emphasis on market-related attributes.

The second survey has extended the scope of the initial survey by including the major downstream actors, namely collecting wholesalers, stationed wholesalers, retailers, and hotel managers. The main focus of this part of the study has been to analyze contractual relations between these actors. Such relationships can affect individual incentives to improve quality, as it has been argued by transaction cost economics theory. While some indicators were available to signal quality, such as the use of variety name or production region, other quality

problems, particularly in the central wet market, such as premature, damaged, and blackened tubers remained. Thus, to respond to these quality problems, contractual relationships between collecting wholesalers and stationed wholesalers were largely trusted-based, as inspecting the quality of a given delivery involves high transaction costs. Likewise, in the relationship between farmers and collecting wholesalers, contractual relationships were largely carried out at farmgate. Buying potatoes at farmgate appears to have helped collecting wholesalers to monitor quality closely. For the farmers, selling potatoes at farmgate tend to offer better incentives to improve quality than selling potatoes at the nearest spot market. The study found that, in the latter case, farmers face high price risk due to a quality measurement problem.

Following the largely explorative approach in the first part of the study, the second part of the present study has specifically addressed the factors affecting ware (consumption potato) farmers' decision to adopt the IVs. The study showed that 73% of ware potato farmers did not even try the IVs at all. The second part of the study has offered insights into the factors leading to the low uptake of the IVs by answering the following research question.

RQ2: *How do the agricultural knowledge and innovation system and smallholder farmers' perception of local varieties affect the adoption of improved potato varieties?*

This study has distinguished the causes of low adoption by examining the role of the agricultural knowledge and innovation system (AKIS) and farmers' preferences for LVs.

Firstly, to understand the underlying causes of low adoption, the study has included several variables related to the AKIS and farmers' perception of LVs, in addition to the household related socio-economic factors found in most adoption studies. The study found that frequency of use of technical assistance from NGOs, use of main buyer as a source of advice, and farmers' access to credit have an effect on farmers' adoption decision. In this study, the variable 'use of main buyer as a source of advice' has been used as a proxy for buyers' preferences for specific varieties. The result showed a negative relationship between buyers' preferences and the likelihood of adopting the IVs. In effect, this finding has confirmed the farmer-based evaluation in the first part of the present study in which the IVs were evaluated low in market-related quality attributes (e.g., stew quality). However, the other AKIS variables such as frequency of use of extension services, technical assistance from research

institutes, and farmer organizations and days spent in farmer training centers showed no relationship with the farmers' adoption decision. Furthermore, regarding the intensity of adoption, only access to credit was (positively) correlated. In general, the key AKIS variables, frequency of use of technical assistance from research and extension services, did not have an effect in the farmers' decision to adopt the IVs.

Secondly, the study has analyzed the relationship between farmers' perception of the quality of the LVs on the adoption of IVs. Understanding this relationship is important because a high value attached to the LVs could lead to a low value attached to the IVs, even if they have favorable attributes, and thus could affect the adoption of IVs. Prior studies have only focused on the relationship of adoption decision and the characteristics of the new technology and/or smallholders' socio–economic characteristics (e.g., Adesina and Baidu-Forson, 1995; Feder et al., 1985; Sall et al., 2000). The study showed that farmers' favorable perceptions of the crop management intensity and drought resistance of LVs have a negative effect on the adoption of IVs. This means that farmers perceived the IVs to require more crop management and to be more susceptible to drought incidents than the LVs. The study found no significance relationship between farmers' perception of LVs regarding disease resistance and yield potential and their decision to adopt the IVs. However, the perception of farmers' regarding the market-related quality attributes of the LVs showed a strong negative relationship with their decision to adopt the IVs. Thus, farmers' positive perception regarding the market-related quality attributes of LVs has a negative effect on the adoption of IVs.

In addition to the formal institutions such as the AKIS, social networks can affect economic exchanges. In this respect, the institution of middleman has been dominant in the potato market. The third part of the present study has identified the main factors that affect farmers' decision to trade through middlemen, and the economic impact of such relationship by answering the following research question.

RQ3: *Which factors do influence farmers' decision to use middlemen in their trading relations, and what is the economic impact of such relationship?*

This research question has been answered in two steps.

Firstly, the study has conceptualized farmers' decision to sell through middlemen as a binary channel choice decision problem by farm households that try to maximize utility. To this effect, the study has included several new variables in addition to those variables found in most channel choice studies. The study identified that education, age, number of livestock units, volume of production, location, and ethnic ties have a strong relationship with farmers' decision to use middlemen in their trading relations with traders. Education, location (district dummy) and ethnic ties showed a strong positive relationship in the farmers' decision to trade through middlemen rather than selling to direct buyers while volume of production and number of livestock units showed a strong opposite relationship. The fact that ethnic ties has a strong positive relationship with the use of middlemen raises an important question regarding the economic outcome of ethnically tied relationships. Following recent trends in food supply chains toward quality and safety requirements, middlemen might be ill-suited to deal with new challenges of quality improvement. This has led to the second objective of this study.

Secondly, to analyze the economic impact of using middlemen in trade relations, the study has used a propensity score matching (PSM) technique in which respondents were grouped into treatment and control groups. The treatment group included those farmers who reported that they used middlemen to sell their potatoes. Likewise, those farmers in the control group were the ones who reported that they sold potatoes to direct buyers. The study has used several procedures to improve the quality of the estimates and to control any selection bias from unobserved covariates. The study showed that farmers who sold to direct buyers had earned more income per hectare than their counterparts who sold potatoes through middlemen. That means that using the institution of middleman in trade relation seems economically inefficient. The study has attributed this result to the (negative) consequences of social ties; 74% of farmers in the treatment group had ethnic ties with the main middleman, while only 31% of farmers in the control group had ethnic ties with the main buyer. The study concludes that farmers' decision to use middlemen in their trading relation is economically inefficient.

While the first three parts of the present study have mainly focused on the ware (consumption) potato market, the last part of the study has focused on the seed potato market, investigating the details of a specific type of institutional arrangement, namely a contract farming scheme. This study has identified different contract design attributes that motivate

smallholders to participate in a contract farming scheme by answering the following research question.

RQ4: *Which contract attributes do motivate smallholders to participate in a contract farming scheme?*

To answer this question, the study has followed three approaches – a literature review, a pilot study, and a survey. The literature review has been carried out to find a menu of contract design attributes used elsewhere. The pilot study has been conducted to select the most important contract design attributes related to three quality uncertainty levels (output market uncertainty, quality uncertainty, and input market uncertainty). Using the analytical hierarchy process (AHP) approach, six out of twelve attributes have been selected, two attributes from each level of uncertainty. In the third approach, a survey has been used to collect data on farmers' preferences for contract attributes, the six contract design attributes – namely price option, contract form, product quality specification, seed quality specification, input supply arrangement, and technical assistance.

By analyzing the survey data using an alternative specific (conditional) logit model, the study has identified the main contract design attributes influencing smallholders' decision to participate in a contract farming scheme. Farmers' showed strong preferences toward a variable price option over a fixed price option; a written contract form over an oral form; a variable output quality specification over a fixed output quality specification; and seed, technical assistance, and inputs supplied by the trading company (buyer firm) rather than being supplied by state agencies or NGOs.

6.2 General discussion and conclusions

Following New Institutional Economics (NIE), markets are only one form of institution fulfilling economic exchanges and providing coordination functions. Distinguishing institutions into the institutional environment and institutional arrangements is important to understand the difference between particular sets of rules and structures governing particular contractual relations. In the NIE framework, the institutional environment provides the context in which the institutional arrangement operates, and consists of property rights, social

norms and traditions, and formal and information enforcement mechanisms, amongst others (Davis and North, 1971)).

Commercialization can allow to fulfill smallholders' diverse consumption bundle and to specialize in production of those crops in which they are relatively skilled (Barrett, 2008). Previous studies on smallholder commercialization in sub-Saharan Africa have mainly focused on traditional or cereals crops. However, these studies may have limited generalizability for the potato crop because of differences in characteristics, notably perishability and bulkiness. Potato, an important crop worldwide, has received little attention, particularly, from a value chain perspective. Enhancing potato farmers' commercialization requires 'getting institutions right', for instance, by making significant investment in production technologies, by availing varieties with market-preferred quality attributes, and by establishing well-functioning input and output markets. This thesis has focused on the role of institutions (institutional environment and institutional arrangements) in quality improvement and market access by analyzing market and contractual relationships between farmers and upstream and downstream value chain actors.

6.2.1 Relationships between farmers and upstream actors

To improve market access, (ware) potato farmers need to grow varieties that are demanded by markets. When improved varieties are made available, for instance, by state research and breeding institutes, these new varieties also must possess the quality attributes that the final markets demand. In Ethiopia, research institutes seem to give the highest priority to developing varieties with enhanced production-related quality characteristics (e.g., yield potential) but do not seem to include market-related quality attributes. The consequence of this is that the majority of (ware) potato farmers in the study area continue to grow LVs, which are relatively inferior regarding the production-related quality attributes. This study has analyzed smallholders' upstream relationships with research institutes and the role of extension, farmer organizations, farmer training centers, NGOs, and access to credit to understand quality alignment problems regarding the low uptake of IVs. Only frequency of use of technical assistance from NGOs and access to credit showed a strong (positive) relationship with smallholders' decision to adopt IVs.

The quality alignment problem related to farmer preferences versus AKIS priorities may relate to several factors. Firstly, the generic nature of information provided by the publicly-sponsored extension system may not be appropriate to make farmers understand specific quality attributes of a new variety; thus, a lack of information might have prevented farmers from growing the IVs. For example, the study, in chapter three, found (strong) negative correlation between adoption decision and crop management intensity, when considering the perception of all farmers. However, when only the perception of those farmers who adopted was considered in the outcome equation, this variable showed no effect. This shows that there is a lack of adequate information about the quality characteristics of the IVs. Secondly, there appears to be a lack of coordination among the three main components of AKIS (national research institutes, regional research institutes, and agricultural universities) and the extension service when diffusing new technologies. A third issue that could explain the misalignment between farmers and AKIS relates to the priorities of the Ethiopian public extension service. This service has received the criticism that extension workers are more focused on input provision rather than on technical assistance (Spielman et al., 2010), and that extension workers lack up-to-date knowledge and skills (Belay and Abebaw, 2004). This situation can negatively affect the adoption of new technologies. Fourthly, the formal AKIS in Ethiopia pays little attention to farmers' experiences and farmers' knowledge. Thus, farmers may not trust the system and thus may not listen to what extension service or research institutes teach them regarding new technologies (e.g., new varieties). Lastly, farmers may indeed see quality differences between the IVs and the LVs. When asked to evaluate quality attributes of several potato varieties, farmers who had experience with IVs gave the highest score for market-related quality characteristics to the LVs.

The above discussion implies that the quality alignment problems related to farmer preferences versus AKIS priorities can only be solved when some form of joint decision making or congruence of objectives is introduced. Although enhanced production-related quality attributes are necessary for developing new varieties, this may not be sufficient to induce farmers to grow IVs.

6.2.2 Relationships between farmers and downstream actors

In addition to farmer-AKIS relations, smallholder commercialization involves several other actors at different levels of the value chain. The relationships between these actors can affect

the alignment of quality, because incentives to improve quality can differ between actors. This thesis has analyzed contractual relationships at dyadic level: between farmers and collecting wholesalers, between collecting wholesalers and stationed wholesalers, between farmers and anonymous buyers in a spot market arrangement in the ware potato market, and between farmers and a trading company in a contract farming arrangement in the seed potato market. In addition, quality is also dependent on other factors such as environmental (e.g., weather condition and disease incidents) and crop management (e.g., weed control, and application of fertilizer and pesticides), and harvest, storage, and transport. The content of the contractual relation can affect the choice farmers make with regard to production processes. For instance, traders can influence the behavior of farmers through a variety of institutional arrangements such as through direct monitoring, quality measurement, input control, and residual claimancy (Hueth et al., 1999). This thesis has analyzed the effect of several institutional arrangements on the alignment of quality and the implication for smallholder commercialization.

In chapter one, it was hypothesized that in the presence of public (third party) quality control systems (e.g., quality certification), it would be more economical for agents to rely on public quality control systems rather than using private mechanisms (Raynaud et al., 2005). However, this does not seem to happen in the Ethiopian potato value chain, perhaps due to lack of well-functioning institutions. Consequently, sellers and buyers have to rely on private mechanisms to control quality, which are discussed below.

In the relationship between farmers and collecting wholesalers, most transactions are carried out at farmgate. Furthermore, as presented in chapter two, more than 56% of harvesting activities were carried out by traders in the study period. This type of arrangement appears to have allowed collecting wholesalers to closely monitor potato quality. Apart from solving the quality uncertainty of downstream actors, this type of relationship indeed has several advantages for smallholders. First, smallholders can negotiate prices before harvest. Given the perishability of potatoes, selling at farmgate will prevent being confronted with opportunistic behavior of traders in the spot market. Second, farmers do not have to search for transportation as this will be arranged by traders. Third, this can avoid other costs such as handling and miscellaneous outlays should they deliver the product to the market. However, in this type of arrangement smallholders have small chance of involving their labor during harvesting as traders may bring their own worker force. This may be a concern (but not

related to quality alignment) if cost of harvest is considered in determining the final payment and if the opportunity cost of household labor is low. The other concern in a farmgate type of arrangement is that this appears to exclude small-scale farmers. Due to economies of scale, traders prefer to transact with those farmers who are able to deliver one full truck, preferably from a single plot. Thus, a farmgate type of arrangement is not available to all farmers. The alternative for small-scale farmers is to carry their potatoes to the nearest market, which brings another quality alignment problem due to differences in incentive to improve quality.

When small-scale farmers sell their potatoes in the nearest market, they are subjected to high price risks due to a quality measurement problem in this market. This can happen due to one or more of the following causes: (1) traders in the spot market transact with several farmers at a time on a specific market day; they do not take much time to inspect the quality of the whole sack they buy; therefore they tend to pay a price for average quality (even if the quality of the potatoes is higher than average) (2) farmers deliver potatoes in a sack in which only the top part is visible for inspection by traders; traders expect that farmers put lower quality at the bottom of the sack; therefore, they tend to pay a price that is lower than the true quality of the potatoes would justify; (3) there is a large difference between the price for low quality potatoes compared to high quality potatoes; thus, the price risk of incorrect measuring of quality is high; and (4) given the perishability of the product and the high transport cost for farmer bringing potatoes to the market, farmers have few alternatives than to sell at the market day. Thus, the conditions in the spot market make farmers to be more vulnerable to a quality measurement problem because when a given delivery is wrongly (or deliberately) judged as low quality by traders a significant portion of their income can be wiped out.

Measuring product quality in spot market type of arrangement is also an imperfect indicator of a farmer's effort (Hueth et al., 1999), because (1) when deliveries are made in large volumes, measuring the quality of each item in a given delivery would be costly for the trader, and measuring a sample of the delivery would not provide a perfect measure of quality; and (2) certain type of quality may not become apparent until the commodity has traveled further downstream thus may put traders for another quality uncertainty. For instance, due to poor storage conditions, potatoes may develop internal sprouting (Sawyer and Dallyn, 1964) that may physically look good at the time of sale, but this could lead to fast external sprouting and spoilage losses for traders. Consequently, traders buying from the nearest spot market may have to either invest much time to verify quality (which is costly),

choose not to monitor quality at all, or use a relatively crude set of grades to measure quality. This thesis found that traders buying in the spot market use a crude measure of quality, which has a negative effect on the prices farmers receive in this market. Thus, selling potatoes in a spot market arrangement provides fewer incentives to improve quality compared to a farmgate type of arrangement.

Most of the relationships between farmers and collecting wholesalers in the potato value chain also involve middlemen. Previous studies have emphasized the positive role of social networks in economic exchanges. The main argument for this positive role is based on the presumption that social bonding, such as ethnic ties, can create homogeneity and thus positively impact business outcomes by reducing transaction costs (Annen, 2003; Fafchamps, 2000). However, this thesis showed that using the institution of middleman in trading relations is welfare reducing because of the lock-in it creates. The study found that personalized relationships between farmers and middlemen lead to high social switching costs (e.g., a loss of a personal bond or friendship) and thus to an ex post monopoly or monopsony situation which leads to lower prices for the farmer's product, (Bansal et al., 2004; Jones et al., 2007).

In the relationship between collecting and stationed wholesalers, a trust-based institutional arrangement seems to be dominant. In this study, a written contract was only observed in the relationship between stationed wholesalers and big hotels. Thus, the coordination between downstream actors is largely enforced implicitly through reputation effects and repeated interactions. In general, the existing contractual relationships between downstream actors can positively affect the alignment of quality in the chain, because trust-based relationships can eliminate the need for formal contracts, which are costly to write, monitor, and enforce (Dyer, 1997).

Even though farmgate and trust-based contractual arrangements discussed before can provide stronger incentives to improve quality for domestic markets, smallholder commercialization in highly remunerative markets, such as the export market, requires a more integrated (formal) type of contractual relations (Masakure and Henson, 2005). A contract farming arrangement is considered an institutional solution to solve smallholder market access problems (e.g. Barrett et al., 2012; Bellemare, 2012; Key and Runsten, 1999). However, the attention paid by the contract farming literature regarding the details of contractual relations

from the perspective of smallholders' is relatively low. This thesis has analyzed seed potato farmers' preferences for contract terms and conditions (so called contract design attributes). The findings showed that smallholders have preferences for a variable price compared to a fixed price, a written form of contract compared to an oral contract, a variable output quality specification, and seed, input, and technical assistance supplied by the trading company instead of by independent suppliers or the state. Based on the findings of this thesis, farmers' preferences for these contract design attributes can largely be explained from the perspective of smallholders' risk aversion behavior on the one hand and entrepreneurship on the other hand.

For the trading company, farmers' preference for a variable price option can help to minimize its risk exposure as the market risk would be borne by the contracted farmers. In addition, this strategy may reduce moral hazard problems by making both contracting parties residual claimants. Nonetheless, a variable price contract increases farmers' price risk. The question is why risk averse farmers may still opt for a variable price option when in fact such strategy may entail higher risk? The thesis found the following explanations. First, farmers perceive prices in a contract farming scheme as low prices, even after accounting for the 'insurance premium' that is inherent in a fixed-price contract. Thus, by choosing a variable pricing option, farmers try to avoid the risk of underpayment. Second, farmers who wish to participate in a contract farming scheme appear to have high entrepreneurial attitude. Thus, fixed price option can be less desirable for these farmers as the final payment will not depend on effort and skills. Third, prices for agricultural products are often on the rise in Ethiopia (Tadesse and Guttormsen, 2011). Thus, farmers have a fear that being locked into a fixed-price contract may penalize them should prices go up significantly. Relatedly, smallholders' preferences for a variable quality specification can be explained from the perspective of risk aversion. Although a variable output quality specification scheme could expose farmers to additional price risk due to problems in measuring quality, this could lead to another major risk (risk of complete rejection) should a given delivery not meet the minimum quality criteria. Thus, by opting for a variable quality specification, farmers know that they will always sell their delivery (even if it is against a low price). Furthermore, preferences for a variable output specification can be explained from the perspective of entrepreneurship. Farmers with such attitudes may believe that they can deliver the best product quality and thus receive the high price the trading company is willing to pay for this quality. Regarding the supply of seed, input, and technical assistance, farmers' choice for the trading company to

deliver these inputs corresponds to their risk averse attitude. From the farmers' perspective, this type of arrangement is a reliable source of supply of proper inputs. Also, supply of inputs by the trading company is a form of risk sharing when producing a crop with specific attributes. Thus, the findings from this thesis support the view that private firms are more trustful and effective than public agencies in timely delivering extension services and supply good quality inputs (e.g. Bellemare, 2012; Umali-Deininger, 1997).

Farmers also showed a strong preference for a written contract over an oral contract. Although this appears to have been paid little attention in the contract farming literature, this thesis has shown the significance of differentiating between contract forms and contract terms because of the implication this may have in a contract farming arrangement. Particularly, in a low trust environment, farmers appear to minimize the risk of non-compliance from the side of the trading company by opting for a written contract in which detailed roles and responsibilities, procedures for monitoring, and penalties for performance non-compliance are specified. The problem with the written form of contract is that it is still incomplete, which makes ex post adjustments difficult (Williamson, 1979).

6.3 Contributions to the literature

The thesis has contributed to the literature, particularly, from the perspective of technology adoption, seller-buyer relationships, and social networks. .

6.3.1 Technology adoption

The thesis has contributed to the literature on technology adoption by conceptualizing adoption decisions as a multi-attribute decision problem involving tradeoffs. Most publicly-sponsored agricultural research is largely driven by food security issues; thus, production-related quality attributes have received high priority in new variety development. This thesis showed that smallholders' willingness to adopt a new variety largely depends on whether the new varieties have the preferred market-related quality attributes.

Previous adoption studies have focused on the relationship between adoption and the characteristics of the new technology (e.g., Adesina and Baidu-Forson, 1995; Sall et al.,

2000), or smallholders' socio-economic characteristics (e.g., Feder et al., 1985). This thesis has taken a step forward by showing the relationship between adoption decision about new varieties and the characteristics of traditional varieties. The thesis has demonstrated that farmers' assessment of production- and market-related attributes of local varieties strongly influence farmers' decision to adopt IVs. Farmers' attachment to local varieties could be due to a lack of adequate knowledge about the quality characteristics and the (crop) management of new varieties. The thesis contributes to the discussion on the significance of the system approach (participatory research approach), which takes farmers and other actors at the center of the innovation process (Hall et al., 2001; Klerkx and Leeuwis, 2008; Leeuwis and Van den Ban, 2004; Smits and Kuhlmann, 2004; Sumberg, 2005).

The thesis has paid due attention to the potato crop, which has become an increasingly important food and cash crop in several developing countries. Potato has received little attention in the adoption literature, particularly compared to other staple crops like rice, maize, and sorghum despite important differences between potato and cereal crops (Ortiz et al., 2013). The findings from traditional adoption literature do not provide sufficient information about the factors that influence farmers' decision to adopt new potato varieties. Furthermore, the thesis has analyzed the effectiveness of AKIS in the adoption decision by taking ware (consumption) potato farmers as a unit of analysis rather than focusing on seed potato farmers. In this regard, the thesis has provided further arguments that the potato innovation system will only be successful when ware potato farmers adopt new varieties.

6.3.2 Seller – buyer relationships

The thesis has provided further argument on the effect of the institutional environment and institutional arrangements regarding the alignment of quality and the implication for smallholder commercialization.

Although spot market arrangements have been extensively studied, particularly from the perspective of transaction cost economics, little research has been done in comparing the effect of farmers' decision to sell in the spot market and at farmgate. Compared to selling to the spot market, selling at farmgate has often been considered less remunerative (Fafchamps and Hill, 2005). One question, which seems overlooked, is the problem of measuring quality that smallholders encounter when they decide to sell in the nearest spot market. The thesis

has provided further insights into the importance of a farmgate type of arrangement in enhancing smallholders' incentive to improve quality and market access, because farmers' effort is better rewarded in this type of arrangement than that of the spot market. Indeed, the transaction cost economics theory has recognized the problem of a spot market arrangement regarding the difficulty of measuring quality. However, such analysis has been largely made from the buyers' perspective; as traders are the ones to be mostly affected because of the difficulty of measuring the performance of the seller (Hueth et al., 1999). This thesis complements to the findings of Muto and Yamano (2009) by showing the importance of a farmgate type of arrangement for smallholders' selling perishable and bulky products, such as potatoes, sweet potatoes, and cassava.

In addition, the thesis has contributed to the contract farming literature by analyzing smallholders' preferences for contract design attributes in the seed potato market. Due to the complexity of seed potato production, smallholders can be exposed to direct transaction costs, (e.g., searching and selecting of the right quality seed and other inputs) and indirect transaction costs (e.g., missing input markets or the failure to identify appropriate trading partners). Furthermore, seed potato production requires specific investment in human capital and inputs. The thesis showed smallholders' tension regarding the input market and output market uncertainty. While the uncertainty in the input market motivates farmers for participation, the risk of underpayment (when accepting a fixed-price contract) and the lack of freedom to make autonomous decisions in the output market tend to refrain them from participation. In this regard, the thesis has provided an argument about the significance of institutional support (for instance, supplying the necessary inputs through farmer organizations) and flexible contracts to ease the tension and thus to stimulate smallholders to participate in contract farming.

6.3.3 Social networks

This thesis has contributed to the discussion on the role of social networks in improving/ hindering smallholder commercialization in the modern economy. By analyzing the factors leading to farmers' reliance on the institution of middleman in the potato trade and the impact of such relationship on economic performance, the thesis showed that ethnic ties can lead to lock-in and thus prevent smallholders from using other types of institutional arrangements, such as formal contracts or preferred seller-buyer relationship, which could improve

smallholders' commercialization in remunerative and quality oriented markets. The findings are in line with Ali and Peerlings (2011), who also have reported the negative effect of ethnically tied relations on economic performance.

6.4 Practical implications

This thesis draws several practical implications, primarily to research institutes and other public agencies and to managers of agribusiness firms.

6.4.1 Implications for research institutes

Chapters two and three have provided lessons for policymakers and researchers about how to increase adoption of improved potato varieties. It was shown that smallholders' production decisions are largely motivated by market conditions. Too much focus of the research institutes on production-related quality attributes can lead to a low adoption rate unless new varieties have market-related quality attributes at least as good as those of the LVs. Research priorities therefore need to be aligned with the quality requirements of downstream actors to enhance the uptake of IVs by ware potato farmers. Subsequently, a high demand for IVs by ware potato farmers would offer a better market for seed potato farmers.

Research institutes and other agencies involved in the innovation process (e.g., the Ministry of Agriculture and Rural Development) need to direct their innovation strategy toward participatory approach. Firstly, a rethinking of the existing innovation diffusion system is necessary toward a system perspective, which involves various actors into the process of setting research priorities or more generally in the innovation process. Secondly, research priorities should not only focus on production-related quality attributes, it should also give equal or even more attention to market-related quality attributes. So far, most attention has been paid to production-related quality attributes due to the high potential of potatoes for food security. However, this thesis has highlighted the significance of potatoes being beyond 'hunger breaker'. In the region where this study was conducted, potato is mainly considered a cash crop and an important product for smallholder commercialization (e.g., 50% of the annual income in 2009/2010 production cycle came from potato sales). Indeed, this could differ from region to region. This thesis further suggests that innovation strategy should

address region specific problems; that is, potato varieties that are needed in food surplus regions may not be equally needed in food deficit regions. Thirdly, the thesis has highlighted the importance of education and access to information in technology adoption. As more than two-thirds of ware potato farmers in the study area have a mobile phone, further effort is needed to disseminate technology-specific information more effectively.

6.4.2 Implications for other public agencies

This thesis has shown that smallholders need institutional supports in several ways. Firstly, even though selling at farmgate provides better incentives to improve quality and market access for ware potato farmers, this type of arrangement appears to exclude small-scale farmers because of they are too small. Establishing village collection centers may encourage traders to buy from these farmers, may even promote further smallholder commercialization. Secondly, middlemen in the potato chain choose to work unnoticed by the formal authorities and appear to have a negative effect on smallholder commercialization. Thus, the activities of middlemen need to become more transparent to promote competition in the value chain and improve smallholders' welfare. Furthermore, educating farmers about the potential benefits of integrated market chains is necessary to overcome the negative aspects of social networks in trading relations. Thirdly, the thesis has shown smallholders' positive perception regarding the potential welfare impact of contract farming. Thus, public institutions should support agribusiness firms that engage in a contract farming scheme through, for instance, establishing infrastructure, facilitating access to credit, and providing other investment incentives. Equally, institutional support is necessary to strengthen smallholders' bargaining position with agribusiness firms, for instance, through farmer organizations (e.g., producer organizations) to make contracts more competitive.

6.4.3 Implications for mangers of agribusiness firms

The thesis has provided important practical implications for managers of agribusiness firms who wish to work with smallholders. Firstly, managers can analyze the motivation of contract farmers toward a contract farming scheme (in a given context) using a multi-category discrete choice model, where the choice of a contract is modeled as a set of different contract design attributes (or contract terms and conditions). For instance, in the context of a seed potato contract farming scheme, this thesis showed that the attractiveness of a contract is largely

determined by the nature of the contract terms and conditions, much less to smallholders' socio-economic characteristics. The thesis has provided the insight that farmers' willingness to participate in a contract farming scheme increases if the contractual relationship is based on a written form; inputs, technical assistance, and seed supplied by the buyer firm; and variable output quality and variable price specifications. Secondly, the thesis has provided further implication for managers that they need to invest more in building trust at the early stage of their contractual relation with farmers, because farmers' preference for a written form of contract implies that they have little trust in the relationship.

6.5 Directions for further research

This thesis has provided several implications for further research.

6.5.1 Further research with respect to the role of the institutional environment

The institutional environment affects economic exchange and smallholder commercialization in many ways. From the formal institutional environment, the role of research and extension services has been examined only in relation to decisions of farmers to adopt new potato varieties or not. Similar studies can be made to assess the role of research and extension in other crops such as wheat, sorghum, and barely in the context of Ethiopia. Such comprehensive analysis will help to guide the decision on research and extension priorities of public-sponsored institutes; more specifically, to help redesign the agricultural and knowledge innovation system in Ethiopia and other countries in sub-Saharan Africa.

From the perspective of informal institutions, the study has only analyzed the role of the middleman in potato trade. The study has focused on the impact of social ties on economic performance. This study can be extended to include other aspects that might have an effect on smallholders' decision to continue trading through middlemen. Furthermore, as the thesis has highlighted the dominance of the institution of middleman in the potato market, future research may look at the role of the institution of middleman in the market for other crops. Also, future research may analyze the efficiency of using middlemen from the traders' perspective and how gain is distributed between farmers, middlemen, and traders.

6.5.2 Further research concerning institutional arrangements

This thesis has considered spot market, farmgate, and trust-based arrangements from the ware potato farmers' perspective, and a contract farming scheme from the seed potato farmers' perspective. In this regard, there are several areas in which researchers may continue.

Firstly, the thesis showed that most transactions regarding ware (consumption) potatoes are carried out in a farmgate type of arrangement. Although this type of arrangement improves quality (alignment) and smallholder commercialization, it limits smallholders from using their labor in the harvesting activity, as this is often done by traders' own workers. Future research may investigate the extent of this problem in the potato value chain and the effect in smallholders' welfare. Secondly, the thesis has analyzed production- and market-related quality attributes of potatoes based on farmers' experience. Thus, an experimental approach could complement this study in asserting the significance of farmer-based characterization of product quality (e.g., by comparing the market quality of the LVs and IVs). Thirdly, chapter 5 has used discrete choice models to analyze the attractiveness of contract design attributes. However, this has two limitations: (1) only limited (and context specific) contract design attributes have been used in the analysis; and (2) the analysis has been made from the perspective of smallholder farmers. Thus, future research may expand this study by including other variables, testing these variables in other crops, and/or by carrying out similar research from the perspective of agribusiness firms.

Summary

Summary

Market access for smallholder farmers in developing countries often requires the improvement of product quality. As products are traded in value chains, quality improvement entails the coordination of activities and decisions by all actors in the chain. Thus, enhancing smallholders' commercialization requires, for instance, making significant investment in production technologies, availing market oriented varieties, and establishing well-functioning input and output markets. Markets are one form of institutions providing coordination functions. From the perspective of new institutional economics (NIE), there are also other types of institutions facilitating economic exchange. Distinguishing the institutional environment and institutional arrangements is important to understand the difference between the particular sets of rules and structures governing contractual relations.

The present thesis aims to gain insights into the factors affecting smallholders to improve quality and market access by analyzing their relationship with upstream and downstream actors and to generate information relevant for the development of sustainable value chains in the potato sector. More specifically the thesis aims to explore:

- *product or technology related quality alignment problems by analyzing interactions between smallholder farmers and upstream actors; and*
- *value chain related quality alignment problems by analyzing interactions between farmers and downstream actors (seller-buyer relationships).*

At the level of the institutional environment, the thesis has aimed to examine the role of agricultural knowledge and innovation system (AKIS) and the institution of the middleman on quality alignment. This type of analysis can provide important insights for economizing on transaction costs in the farmer-upstream and downstream relationships. At the micro level of analysis, the thesis has aimed to examine the effect of several institutional arrangements, namely, spot market, farmgate, trust-based, and contract farming arrangements, on quality alignment. Such analysis is important to evaluate a broad range of institutional arrangements and to search for the appropriate ones that can shape and monitor economic activities in the context of less-developed agrifood chains such as the potato value chain in Ethiopia. To achieve the aims, this thesis has been structured around four research questions.

Chapter two aims to answer the following research question:

How do farmer and trader preferences for specific quality attributes and coordination mechanisms in farmer-trader relationships affect the alignment of quality in the Ethiopian potato value chain?

This question has been addressed in two steps.

In the first step, seven varieties (consisting of three improved and four 'local' varieties) were identified based on a pilot study. Also, quality characteristics were categorized into production-related quality attributes (yield, disease resistance, maturity period, farm management practices, and drought tolerance) and market-related quality attributes (stew quality, cooking quality, tuber size, and tuber color). Next, a survey was conducted among 346 (ware) potato farmers to evaluate the production- and market-related quality attributes of these varieties. One question that needed to be answered was whether these varieties indeed have significant quality differences as perceived by farmers. Farmer-based evaluation of the different varieties showed that these varieties differ, particularly, with respect to tuber size, stew quality, yield, maturity period, and disease tolerance. Furthermore, the findings showed that no one variety has superior quality in both the production- and market-related quality attributes. While the improved varieties (IVs) were evaluated highest in terms of production-related quality attributes (yield and disease tolerance), the local varieties (LVs) were evaluated highest regarding market-related quality attributes (e.g., stew quality). Consequently, farmers are faced with trade-offs when choosing one variety over the other. Another question relates to the relative influence of different quality attributes on farmers' variety choice. The findings showed that potato farmers' variety choice is more influenced by the market-related quality attributes than by the production-related quality attributes. In situations with a trade-off, ware potato farmers tend to align their production decision with the quality demand of downstream actors by growing the LVs.

In the second step, another survey was conducted among the major downstream actors, namely collecting wholesalers, stationed wholesalers, retailers, and hotel managers, to understand the quality requirements of these actors (that may have an effect on smallholders' variety choice) and to analyze seller-buyer relationships affecting individual incentives to

improve quality. The findings showed that tuber size (moderate size tubers) and color (white/yellowish) are the most important market-related quality attributes demanded by the downstream actors. In the relationship between farmers and downstream actors, different quality signaling mechanisms, such as variety name or production region, are used. However, there are other quality problems (such as premature, damaged, and blackened tubers) that cannot be verified using such mechanisms. Thus, in dealing with these quality problems, contractual relationships between downstream actors (collecting wholesalers and stationed wholesalers) are largely trust-based. Likewise, in the relationship between farmers and collecting wholesalers, contractual relationships are largely carried out at farmgate. Nonetheless, the farmgate type of arrangement appears to have excluded small-scale farmers. When these farmers take their potatoes to the nearest spot market, they face high price risk due to a quality measurement problem. Even though traders are also facing a quality measurement problem, the findings show that farmers are more severely affected than the traders. In the farmer-buyer relationships, the main cause of misalignment is difference in incentives to improve quality between farmers that sell in the nearest spot market and the (anonymous) buyers in this market. In this respect, the findings provide further insights into the problem of quality alignment in a spot market arrangement.

Chapter three continues to analyze the main factors affecting the uptake of IVs by specifically addressing the following research question.

How do the agricultural knowledge and innovation system and farmers' perception of local varieties affect the adoption of improved potato varieties?

To examine the role of AKIS, this study included the following variables: frequency of use of technical assistance from research, extension services, NGOs, and/or farmer organizations (cooperatives); training in farmer training center; use of main buyer as a source of advice; and access to credit. The study showed that frequency of use of technical assistance from NGOs, use of main buyer as a source of advice, and access to credit have an effect on farmers' adoption decision. While frequency of use of technical assistance from NGOs and access to credit showed a positive relationship, the use of main buyer as a source of advice showed a negative relationship. This result confirmed the farmer-based evaluation as presented in chapter two in which the IVs were evaluated low in market-related quality attributes. The other AKIS variables showed no significant relationship with farmers'

adoption decision. However, only access to credit was positively related to the extent of adoption (amount of land allotted for growing the IVs).

Regarding the relationship between farmers' perception about the production- and market-related quality attributes identified in chapter two, the findings in chapter three showed that farmers' perceptions for crop management intensity and drought resistance of LVs have an effect on the adoption of IVs. This means that farmers perceived the IVs to require more crop management and to be more susceptible to drought incidents than the LVs. The study also found no significance relationship between farmers' perception of LVs regarding disease resistance and yield potential and the decision to adopt the IVs. On the other hand, tuber size and stew quality have a significant influence on (ware) potato farmers' decision regarding the extent (a portion) of land to be used for growing the IVs. Thus, while both production- and market-related quality attributes are important factors in farmers' decision to adopt IVs, market-related quality attributes tend to influence both the probability and intensity of adoption. This further confirms the importance of market-related quality attributes in farmers' adoption decision.

In addition to the variables related to AKIS and quality attributes, the second study has also analyzed the effect of socio-economic variables on the adoption decision. Education level and the presence of a radio and/or television showed a strong positive relationship with adoption while the number of livestock units showed negative relationship with the decision to adopt. A farmer being male and the size of the family also showed a positive relationship with adoption (but only marginally). Alternatively, having a large portion of own land showed a strong positive relationship with the extent of adoption.

Chapter four aims to examine the role middleman on smallholder commercialization. It is widely recognized that intermediaries can play an important role under conditions of contract uncertainty and positive transaction costs and may thus facilitate trade by decreasing transaction costs related to search time and information asymmetry. However, there are also concerns that such institutions could force individuals to cooperate according to social norms even if this is against their own self-interest. The institution of middleman may decrease efficiency, for instance, by excluding new entrants from participating in the market or by applying price collusion. Overall, the literature provides mixed evidence about the role of middlemen in smallholders' trading relations with buyers. Therefore, chapter four has

empirically examined the factors that influence smallholders to trade with middlemen and the effect of this relationship on the economic outcome, by addressing the following question.

Which factors do influence farmers' decision to use middlemen in their trading relations, and what is the economic impact of such relationship?

To identify the factors influencing smallholders' decision to trade through middlemen, the study has conceptualized it as a binary channel choice decision problem by farm households that try to maximize utility. Of the randomly selected 346 farmer, 68% of them sold potatoes through middlemen. Using a probit model, the study showed that education, age, number of livestock units, volume of production, location, and ethnic ties significantly affect farmers' decision to use (or not) the institution of middleman. Next, after controlling for selection bias using propensity score matching, the study estimated the economic impact of such trading relationship. The findings showed that smallholders who relied on middlemen had 39% lower income per hectare than those farmers who sold to direct buyers. This finding suggests that the middleman institution is ill-suited to deal with new challenges in the modern economy and may even prevent the emergence of other forms of governance, such as contracts and preferred seller-buyer relationships, by locking farmers in existing relationships in which social switching costs appear to be high.

Chapter five focuses on a more formal type of institution, the contract farming arrangement. While contract farming (CF) can enhance smallholders' income in developing countries, empirical research on the motivation of smallholders to participate in CF is scarce. With the objective of providing insights into contractual relations that can induce smallholders to participate in CF, chapter five has addressed the following research question.

Which contract attributes do motivate smallholders to participate in a contract farming scheme?

The general hypothesis of this study is that smallholders' motivation to participate in CF largely depends on the nature of the contract attributes (so-called contract design attributes). This hypothesis was tested by applying alternative specific (conditional) logit model, following a literature review and an AHP approach to select the contract design attributes included in the model, which also relate to three levels of uncertainty: output market

uncertainty, quality uncertainty, and input market uncertainty. In doing so, six out of twelve contract design attributes were selected, namely, price option, contract form, product quality specification, seed quality specification, input supply arrangement, and technical assistance, in relation to the three levels of quality uncertainty. The findings showed that smallholders have strong preferences for a variable price option over a fixed price option; a written contract form over an oral form; a variable output quality specification over a fixed output quality specification; and seed, technical assistance and inputs supplied by the trading company (buyer firm) rather than having these inputs supplied by state agencies or NGOs. Overall, smallholders' choice for written contract over oral form; variable over fixed quality specification; and firm-supplied seed, inputs and technical assistance over government agencies or NGOs can be explained from the risk averse behavior of smallholders (households). On the other hand, smallholders' choice of variable price over fixed price can be explained from entrepreneurial attitude of smallholders wishing to work in a contract farming arrangement.

In sum, the four research questions raised in chapter one have allowed the present study to explore the challenges and opportunities to improve quality and market access in the Ethiopian potato value chain.

Regarding the upstream relationships, smallholders' variety selection decision is largely dependent on market-related quality attributes. Thus, enhancing the uptake of new varieties requires the development of varieties with market-related quality attributes, adequate information exchanges, and joint (or delegated) decision-making. The implication is that research institutes and other agencies need to involve more actors in deciding on the innovation goals as outlined in the participatory innovation diffusion approach.

With regard to seller-buyer relationships, the thesis provides several contributions.

First, a farmgate type of arrangement provides collecting wholesalers better opportunity to closely monitor quality while, at the same time, allowing smallholders to minimize the risk of opportunistic behavior of traders in the spot market. However, a farmgate type of arrangement is not available for all farmers; thus a spot market arrangement remains a concern for small-scale farmers because of the high price risk related to measuring quality. This type of arrangement entails high transaction costs for sellers of perishable and bulky

products. Second, the relationship between smallholders and collecting wholesalers is also negatively affected by the involvement of middlemen. This could lead to welfare losses because of the undesirable consequence of ethnic ties to lock-in. Third, the relationship between downstream actors is largely trust-based. This relationship appears to be more efficient as it eliminates the need for formal contracts, which are costly to write, monitor, and enforce. Lastly, even though farmgate and trust-based contractual relationships can provide better incentives to improve quality for the national market, smallholder commercialization in highly ruminative markers, such as the regional market, needs more integrated type of contractual relations, such as contract farming arrangement. To this effect, the thesis provides an analytical framework to analyze contractual relations in a contract farming scheme by conceptualizing smallholders' preferences as a multi-category discrete choice problem, where the choice of a contract is modeled as a set of different contract design attributes. The implication for agribusiness managers is that they can use this approach to design context specific contracts. In the context of this study, smallholders' preferences for the different contract design attributes can be explained from the perspectives of their risk aversion behavior and entrepreneurship attitudes. Institutional support in the input and output markets is important to strengthen smallholders' bargaining position leading to competitive contract offers.

Samenvatting

Samenvatting

De aardappel is wereldwijd een belangrijk gewas geworden, met name vanwege de veranderingen in het individuele consumptiegedrag en het consumentenbewustzijn van de aardappel als gezond voedsel. Vandaar dat het voor het versterken van de commercialisering van de aardappelboer nodig is om “instituten goed te krijgen”. Bijvoorbeeld door significante investeringen te doen in productietechnologieën, door gebruik te maken van marktgeoriënteerde variëteiten en door het opzetten van goed functionerende input en output markten. Markten zijn een vorm van instituten die coördinerende functies verschaffen. Vanuit het *new institutional economics (NIE)* perspectief zijn er ook andere type instituten die economische uitwisselingen faciliteren. Instituten onderverdelen in het institutionele milieu en de institutionele maatregelen is belangrijk om het verschil tussen de bepaalde groepen regels en structuren te begrijpen voor bepaalde contractuele relaties.

Deze thesis streeft ernaar om inzicht te verkrijgen in de factoren die kleine boeren beïnvloeden om kwaliteit en markttoegang te verbeteren, door hun relatie met stroomopwaartse en stroomafwaartse actoren te analyseren en om informatie te genereren die relevant is voor het ontwikkelen van duurzame *value chains* in de aardappelsector. Om precies te zijn heeft deze thesis als doel om:

- *Product of technologie gerelateerde quality alignment problemen te onderzoeken door interacties tussen kleine boeren en stroomopwaartse actoren te analyseren; en*
- *value chain gerelateerde quality alignment problemen te onderzoeken door interacties tussen boeren en stroomafwaartse actoren (verkoper-koper relaties) te analyseren.*

Op het niveau van het institutionele milieu, is het doel van deze thesis om de rol van zowel agriculturele kennis en innovatiesystemen (AKIS) als de rol van het instituut van de tussenpersoon in *quality alignment* te onderzoeken. Dit type analyse is belangrijk om te

bezuinigen op transactiekosten in de boeren-stroomopwaartse (stroomafwaartse) relaties. Op het microniveau van deze analyse is het doel van deze thesis te onderzoeken wat het effect is

van verschillende institutionele maatregelen, namelijk *spot market*, *farm gate*, op vertrouwen gebaseerde en contractuele landbouw overeenkomsten op *quality alignment*. Een dergelijke analyse is belangrijk om een breed scala aan institutionele maatregelen te evalueren en om te zoeken naar de geschikte maatregelen die economische activiteiten kunnen vormen en monitoren in de context van minder ontwikkelde agrifood ketens, zoals de aardappel *value chain* in Ethiopië. Om het doel van deze thesis te bereiken is het onderzoek geformuleerd aan de hand van vier onderzoeksvragen.

Hoofdstuk twee heeft als doel de volgende onderzoeksvraag te beantwoorden:

Hoe beïnvloeden de voorkeuren van boer en handelaar voor specifieke kwaliteitskenmerken en coordinatie mechanismesn in de boer-handelaar relatie de quality alignment in de Ethiopische aardappel value chain?

Deze vraag is behandeld in twee delen.

In het eerste deel werden zeven variëteiten (bestaande uit drie verbeterde and vier ‘lokale’ variëteiten) geïdentificieerd op basis van een pilot study. Deze zijn later gecategoriseerd in product gerelateerde kwaliteitskenmerken (rendement, ziekteresistentie, rijpperiode, boerderij management praktijken, en droogte tolerantie) en marktgerelateerde kwaliteitskenmerken (stoofpotkwaliteit, kookkwaliteit, knolgrootte, en knol kleur). Vervolgens werd er een survey afgekomen onder 346 aardappelboeren om de productie en marktgerelateerde kwaliteitskenmerken van deze variëteiten te evalueren (op een vijf-punts Likert schaal). Een vraag die beantwoord moest worden was of deze varïeteiten inderdaad significante kwaliteitsverschillen hebben in de ogen van boeren. De evaluatie van de boeren van de verschillende variëteiten laat zien dat deze variëteiten verschillen, met name met betrekking tot knolgrootte, stoofpot kwaliteit, oogst, rijpperiode, en ziekteresistentie. Bovendien lieten de bevindingen zien dat geen enkele variëteit superieure kwaliteit heeft in zowel de productie als de marktgerelateerde kwaliteitskenmerken. Hoewel de verbeterde variëteiten (*improved*

varieties, IVs) het hoogst geëvalueerd werden met betrekking tot productiegerelateerde kwaliteitskenmerken (oogst en ziekteresistentie), werden de 'lokale' variëteiten (*local varieties*, LVs) het hoogst geëvalueerd aangaande marktgerelateerde kwaliteitskenmerken (bijvoorbeeld stoofpotkwaliteit). Vandaar dat boeren een trade-off moeten maken wanneer ze voor de ene variëteit kiezen in plaats van een andere. Dit leidt tot een andere vraag 'Welke kwaliteitskenmerken hebben de meeste invloed op de keus van de boer voor een bepaalde variëteit?'. De bevindingen lieten zien dat de keuze van de boeren voor een bepaalde variëteit meer beïnvloed wordt door marktgerelateerde kwaliteitskenmerken dan door productiegerelateerde kwaliteitskenmerken. Wanneer er sprake is van een discrepantie, dan hebben aardappelboeren die hun aardappelen verkopen voor consumptie de neiging om de productie beslissing in overeenstemming te brengen met de kwaliteitseisen van stroomafwaartse actoren door LVs te verbouwen. Dit benadrukt het belang van marktgerelateerde kwaliteitskenmerken voor de variëteitskeuze.

In het tweede de werd een andere survey afgenomen onder de grote stroomafwaartse actoren, namelijk inzamelende groothandelaren, locatiegebonden groothandelaren, detailhandelaren en hotel managers. Deze survey werd afgenomen om the kwaliteitskenmerken van deze actoren (die mogelijk effect hebben op de variëteitskeuze van kleine boeren) te begrijpen en om verkoper-koper relaties te analyseren die invloed hebben op de individuele stimulans om kwaliteit te verbeteren. De bevindingen lieten zien dat knolgrootte (gematigd grote knollen) en kleur (witachtig/geelachtig) de belangrijkste marktgerelateerde kwaliteitskenmerken zijn die de meeste stroomafwaartse actoren eisen. In de relatie tussen boeren en stroomafwaartse actoren worden verschillende systemen gebruikt om kwaliteit te signaleren, zoals variëteitsnaam of productie regio. Desondanks zijn er andere kwaliteitsproblemen (zoals premature, beschadigde of zwarte knollen) die niet te controleren zijn door het gebruik van dergelijke mechanismen. Dus, om te reageren op deze kwaliteitsproblemen, waren contractuele relaties tussen stroomafwaartse actoren (inzamelende groothandelaren en locatiegebonden groothandelaren) met name gebasseerd op vertrouwen. In de relatie tussen boeren en inzamelende groothandelaren werden contractuele relaties grotendeels uitgevoerd buiten de boerderij (*at farmgate*). Desalniettemin lijkt de *farmgate* regeling kleine boeren te hebben buitengesloten. Wanneer boeren hun aardappel naar de dichtstbijzijnde *spot market* brengen worden zij geconfronteerd met een hoog prijsrisico vanwege problemen in de meetbaarheid van de kwaliteit. Hoewel het probleem van de meetbaarheid van de kwaliteit

een evenredige betrekking heeft op handelaren, lieten de bevindingen zien dat boeren zwaarder geraakt worden dan de handelaren. In de boer-koper relaties is de hoofdoorzaak van *misalignment* het verschil in stimulans tussen boeren die op de dichtstbijzijnde *spot market* verkopen en de (anonieme) kopers in deze markt om de kwaliteit te verbeteren. In dit opzicht geven de bevindingen meer inzicht in het probleem van *quality alignment* in een *spot market* regeling (vanuit het perspectief van de boeren) waar verschilde boeren op een vaste marktdag hun aardappelen aanbieden.

Hoofdstuk drie gaat verder met het analyseren van de factoren die de opname van IVs beïnvloeden, door de volgende specifieke onderzoeksvraag te behandelen.

Hoe beïnvloeden het agriculturele kennis- en innovatiesysteem en de perceptie van boeren van lokale variëteiten het opnemen van verbeterde aardappel variëteiten?

Om de rol van AKIS te onderzoeken bevat deze studie verschillende variabelen, namelijk frequentie gebruik technische assisatentie van onderzoek, uitbreidingsdiensten, NGO's, en/of boeren organizaties (cooperaties), training in boeren training centers, gebruik van voornaamste afnemer als bron van advies en toegang tot krediet. De variabele 'gebruik van voornaamste afnemer als bron van advies' was gebruikt als indicator om van stroomafwaartse actoren de perceptie van de IV's te begrijpen. De studie toonde aan dat de frequentie van gebruik van technische assistentie van NGO's, gebruik van voornaamste afnemer als bron van advies en toegang tot krediet effect hebben op de boers keuze voor opname van verbeterde aardappel variëteiten. Frequentie van gebruik van technische assistentie van NGO's en toegang tot krediet lieten een positieve relatie zien, terwijl gebruik van voornaamste afnemer als bron van advies een negatieve relatie aangaf. Dit resultaat bevestigt de evaluatie van boeren in Hoofdstuk 2 waarin de IVs laag werden geëvalueerd op marktgerelateerde kwaliteitskenmerken. De andere AKIS variabelen lieten geen significante relatie zien met de boers keuze voor opname van verbeterde aardappel variëteiten. Desalniettemin was alleen toegang tot krediet positief gerelateerd aan de uitbreiding van opname (hoeveelheid land toegekend aan het verbouwen van IVs).

Betreft de relatie tussen perceptie van de boeren op de productie- en marktgerelateerde kwaliteitskenmerken zoals vastgesteld in Hoofdstuk twee, toonden de bevindingen in Hoofdstuk drie aan dat de perceptie van boeren op gewas management intensiteit en droogte tollerantie van LVs een negatief effect hebben op de opname van de IVs. Dit betekent dat boeren van mening zijn dat de IVs meer gewas management nodig hebben en gevoeliger zijn voor droogte incidenten dan de LVs. De studie vond ook dat er geen significante relatie bestaat tussen de perceptie van de boeren op LVs wat betreft ziekte resistentie en oogst potentieel en de keuze om de IVs aan te nemen. Aan de andere kant hebben knolgrootte en stoofpotkwaliteit een significante invloed op de beslissing van de aardappel boeren aangaande de grootte (een deel) van het land dat gebruikt wordt voor het verbouwen van IVs. Dus, hoewel zowel productie- als marktgerelateerde kwaliteitskenmerken belangrijke factoren zijn in de beslissing om IVs aan te nemen, neigen marktgerelateerde kwaliteitskenmerken zowel de waarschijnlijkheid als de intensiteit van aanname te beïnvloeden. Dit bevestigt wederom het belang van marktgerelateerde kwaliteitskenmerken voor de keuze voor aanname van verbeterde variëteiten.

Naast de variabelen gerelateerd aan AKIS en kwaliteitskenmerken, onderzocht de tweede studie ook het effect van socio-economische variabelen op de aanname keuze. Onderwijsniveau, aanwezigheid van radio en/of tv lieten een sterke relatie met de aanname keuze zien, terwijl het aantal vee eenheden een negatieve relatie met aanname keuze aantoonde. Een mannelijke boer en familiegrootte gaven ook een positieve relatie aan met aanname keuze (echter marginaal). Anderzijds had het hebben van een groot eigen land een positieve relatie met de omvang van de aanname van verbeterde variëteiten.

Hoofdstuk vier heeft als doel de rol van de informele institutie (tussenpersoon) in de commercialisering van de kleine boer te onderzoeken. Het is algemeen erkend dat tussenpersonen een belangrijke rol kunnen spelen onder omstandigheden van contract onzekerheid en positieve transactiekosten en dus handel kunnen vergemakkelijken door de transactiekosten gerelateerd aan zoek tijd en asymmetrische informatie te verlagen. Desalniettemin zijn er ook situaties waarin dergelijke instituties ervoor kunnen zorgen dat individuen samenwerken volgens sociale normen, zelfs als dit tegen hun eigenbelang indruist.

Op deze manier kunnen zij dus de efficiëntie verlagen door, bijvoorbeeld, nieuwe binnenkomers te weren van participatie in de markt door heimelijke prijscomplotten toe te passen. Globaal gezien klinkt er uit de literatuur verschillend geluid over de rol van de tussenpersoon in de handelsrelatie van kleine boeren en kopers. Vandaar dat Hoofdstuk vier empirisch heeft onderzocht welke factoren invloed hebben op de keuze van kleine boeren om handel te drijven via tussenpersonen en het effect van deze relatie op het economische resultaat, door de volgende vraag te adresseren.

Welke factoren beïnvloeden de beslissing van de boeren om een tussenpersoon te gebruiken in hun handelsrelaties en wat is de economische impact van een dergelijke relatie?

Om de factoren te identificeren die invloed hebben op de keuze van kleine boeren om handel te drijven via tussenpersonen, heeft de studie deze keuze geconceptualiseerd als binair kanaalkeuze beslissingsprobleem van boeren die het nut proberen te maximaliseren. Van de 346 willekeurig geselecteerde boeren verkocht 68% hun aardappelen via tussenpersonen. Door het *probit model* toe te passen liet het onderzoek zien dat opleiding, leeftijd, aantal vee eenheden, productievolume, locatie en etnische banden de beslissing om wel (of niet) het instituut van een tussenpersoon te gebruiken significant beïnvloeden. Vervolgens, na controleren op selectie bias door *propensity score matching*, schatte de studie de economische impact van een dergelijke handelsrelatie. De bevindingen tonen aan kleine boeren die afgaan op tussenpersonen een 39% lager inkomen per hectare hadden dan de boeren die aan directe kopers verkochten. Deze bevindingen suggereren dat het instituut van de tussenpersoon niet geschikt is om om te gaan met nieuwe uitdagingen in de moderne economie en zelfs mogelijk de opkomst van andere manieren van bestuur, zoals contracten en *preferred seller-buyer* relaties, kunnen verhinderen door boeren op te sluiten in bestaande relaties met, ogenschijnlijk, te hoge sociale *switching costs*.

Hoofdstuk vijf focust op een meer formeel type instituut, namelijk de contractuele landbouw overeenkomst. Hoewel contractuele landbouw (*contract farming, CF)* het inkomen van kleine boeren in ontwikkelingslanden kan verhogen, is empirisch onderzoek naar de motivatie van kleine boeren om deel te nemen in CF zeldzaam. Met het doel om inzicht te geven in

contractuele relaties die kleine boeren ertoe bewegen deel te nemen in CF, behandelt hoofdstuk vijf de volgende vraag.

Door welke contractuele kenmerken worden boeren gemotiveerd om deel te nemen in een contractueel landbouw project?

De algemene hypothese van dit onderzoek is dat de motivatie van kleine boeren om deel te nemen in CF grotendeels afhankelijk is van het karakter van de contractuele kenmerken (de zogeheten *contract design attributes*). Deze hypothese was getest door een alternatief specifiek (conditioneel) *logit model* toe te passen, in navolging van een *literature review* en een AHP aanpak, om zo de *contract design attributes* te selecteren die opgenomen zijn in het model. Deze zijn verwant aan drie niveaus van onzekerheid: output markt onzekerheid, kwaliteitsonzekerheid, en input markt onzekerheid. Op deze manier werden zes van de twaalf *contract design attributes* geselecteerd, namelijk: prijskeuze, vorm van het contract, specificatie van productkwaliteit, specificatie van zaadkwaliteit, een regeling van de aanvoer van input en technische ondersteuning – in relatie tot de drie niveaus van kwaliteitsonzekerheid. De bevindingen tonen aan dat boeren een sterke voorkeur hebben voor een variabele prijskeuze in plaats van een vaste prijskeuze; een geschreven contract in plaats van mondeling; een variabele specificatie van productkwaliteit in plaats van een vaste; en dat zaden, technische ondersteuning en input voorzien worden door de handelaar (kopende partij) in plaats van overheidsinstellingen of NGO's. In het algemeen kunnen de keuze van de kleine boeren voor geschreven contracten in plaats van mondelinge contracten, de keuze van variabele in plaats van vaste kwaliteitsspecificaties en de voorkeur voor de koper als leverancier van zaad en technische ondersteuning in plaats van overheidsinstellingen of NGO's verklaard worden vanuit het risico vermijdend gedrag van de kleine boeren. Aan de andere kant kan de keuze van een variabele prijs in plaats van een vaste prijs verklaard worden vanuit de ondernemende instelling van kleine boeren die volgens contractuele landbouw regelingen willen werken.

Samenvattend maken de vier onderzoeksvragen, zoals geopperd in hoofdstuk een, het mogelijk om in deze studie de uitdagingen en mogelijkheden in het verbeteren van de kwaliteit en markttoegang in de Ethiopische aardappel *value chain* te onderzoeken.

Betreft de stroomopwaartse relaties is de variëteitkeuze van de kleine boeren grotendeels afhankelijk van de marktgerelateerde kwaliteitskenmerken. Dus het versterken van de opname van nieuwe variëteiten vereist het ontwikkelen van marktgeoriënteerde variëteiten, adequate informatie uitwisseling en gezamenlijke (of gedelegeerde) besluitvorming. Het gevolg is dat onderzoeksinstituten en andere organisaties verschillende actoren bij het innovatieproces moeten betrekken, zoals beschreven in de *participatory innovation diffusion* benadering.

Met betrekking tot de verkoper-koper relaties, heeft deze thesis verschillende bijdragen.

Ten eerste, een *farmgate* overeenkomst geeft inzamelende groothandelaren betere mogelijkheden om kwaliteit nauw te monitoren en geeft tegelijkertijd kleine boeren de kans om opportunistisch gedrag van handelaren op de *spot market* te minimaliseren. Desondanks is een *farmgate* overeenkomst niet mogelijk voor alle boeren. De *spot market* overeenkomst blijft dus een zorg voor kleinschalige boeren vanwege het hoge prijsrisico dat gepaard gaat met kwaliteitsmetingen. Dit type overeenkomst betekent hoge transactiekosten voor verkopers van bederfelijk waar of bulkgoederen. Ten tweede, de relatie tussen kleine boeren en inzamelende groothandelaren wordt negatief beïnvloed door de aanwezigheid van tussenpersonen. Dit kan leiden tot verlies in welvaart, vanwege ongewenste gevolgen van insluitende etnische banden. Ten derde is de relatie tussen stroomafwaartse actoren voornamelijk gebaseerd op vertrouwen. Deze relatie lijkt efficiënter te zijn, omdat het de behoefte aan formele contracten wegneemt. Deze contracten zijn gewoonlijk kostbaar om op te stellen, te monitoren en te handhaven. Tenslotte, hoewel *farmgate* en relaties gebaseerd op vertrouwenscontracten betere stimuli zijn om de kwaliteit voor de nationale markt te verbeteren, is er voor commercialisatie van boeren in meer “herkauwende” markten, zoals de regionale markt, een meer geïntegreerd type contractuele relatie nodig. Een voorbeeld hiervan is de contractuele landbouw regeling. Deze thesis geeft een analytisch kader om contractuele relaties in een contractueel landbouw project te analyseren door de voorkeuren

van de boeren te conceptualiseren als een multi-categorie discreet keuzeprobleem, waarbij de keuze voor een contract is gemodelleerd als een set van verschillende *contract design attributes*. Het gevolg voor agribusiness managers is dat zij deze benadering kunnen gebruiken om contextspecifieke contracten op te stellen. In de context van dit onderzoek kunnen de voorkeuren van de kleine boeren voor de verschillende *contract design attributes* verklaard worden vanuit het perspectief van risico vermijdend gedrag en een ondernemende instelling. Institutionele ondersteuning in de input en output markt is belangrijk in het versterken van de onderhandelingspositie kleine boeren, wat leidt tot concurrerende contractaanbiedingen.

References

References

Abadi Ghadim, A.K., Pannell, D.J. and Burton, M.P., 2005. Risk, uncertainty, and learning in adoption of a crop innovation. Agricultural Economics 33 (1), 1-9.

Abate, T., Shiferaw, B., Gebeyehu, S., Amsalu, B., Negash, K., Assefa, K., Eshete, M., Aliye, S. and Hagmann, J., 2011. A systems and partnership approach to agricultural research for development: Lessons from Ethiopia. Outlook on Agriculture 40 (3), 213-220.

Abdul, R., Muhammad, S., Chaudry, K.M., Aulakh, M.A. and Ahmed, Z., 2012. Identification and proritization of problems faced by rice growers: A case study of Tehsil Daska, Sialkot. Pakistan Journal of Agricultural Sciences 49 (3), 407-410.

Abdulai, A. and Huffman, W.E., 2005. The diffusion of new agricultural technologies: The case of crossbred-cow technology in Tanzania. American Journal of Agricultural Economics 87 (3), 645-659.

Abebaw, D. and Haile, M.G., 2013. The impact of cooperatives on agricultural technology adoption: Empirical evidence from Ethiopia. Food Policy 38 (0), 82-91.

Abebe, G.K., Bijman, J., Ruben, R., Omta, O. and Tsegaye, A., 2010. The role of potato cooperatives in Ethiopia in improving quality and reducing transaction costs., paper presented at the 9th Wageningen International Conference on Chain and Network Management. Wageningen, The Netherlands, 26-28 May 2010. http://edepot.wur.nl/171496.

Abebe, G.K., Bijman, J., Kemp, R., Omta, O., Tsegaye, A., 2013. Contract farming configuration: Smallholders' preferences for contract design attributes. Food Policy 40, 14-24.

Abidin, P.E., 2004. Sweetpotato breeding for northeastern Uganda: Farmer varieties, farmer-participatory selection, and stability of performance. PhD dissertation, Wageningen University.

Adesina, A.A. and Baidu-Forson, J., 1995. Farmers' perceptions and adoption of new agricultural technology: evidence from analysis in Burkina Faso and Guinea, West Africa. Agricultural Economics 13 (1), 1-9.

Adhiguru, P., Birthal, P.S. and Kumar, B.G., 2009. Strengthening pluralistic agricultural information delivery systems in India. Agricultural Economics Research Review 22 (1), 71-79.

Akerlof, G.A., 1970. The market for "lemons": Quality uncertainty and the market mechanism. The Quarterly Journal of Economics, 488-500.

Alem, Y. and Söderbom, M., 2012. Household-Level consumption in urban Ethiopia: The effects of a large food price shock. World Development 40 (1), 146-162.

Alene, A.D., Manyong, V., Omanya, G., Mignouna, H., Bokanga, M. and Odhiambo, G., 2008. Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya. Food Policy 33 (4), 318-328.

Alesina, A. and La Ferrara, E., 2005. Ethnic diversity and economic performance. Journal of economic literature 43 (3), 762-800.

Ali, M. and Peerlings, J., 2011. Ethnic ties in trade relationships and the impact on economic performance: The case of small-scale producers in the Handloom Sector in Ethiopia. Journal of Development Studies 47 (8), 1241-1260.

Annen, K., 2003. Social capital, inclusive networks, and economic performance. Journal of Economic Behavior & Organization 50 (4), 449-463.

Bansal, H.S., Irving, P.G. and Taylor, S.F., 2004. A three-component model of customer to service providers. Journal of the Academy of Marketing Science 32 (3), 234-250.

Barrett, C.B., 2005. Market institutions in Sub-Saharan Africa: Theory and evidence. American Journal of Agricultural Economics 87 (4), 1089-1090.

Barrett, C.B., 2008. Smallholder market participation: concepts and evidence from eastern and southern Africa. Food Policy 33 (4), 299-317.

Barrett, C.B., Bachke, M.E., Bellemare, M.F., Michelson, H.C., Narayanan, S. and Walker, T.F., 2012. Smallholder participation in contract farming: Comparative evidence from five countries. World Development 40 (4), 715-730.

Batt, P.J., 2003. Building trust between growers and market agents. Supply Chain Management-an International Journal 8 (1), 65-78.

Baum, C., Nichols, A. and Schaffer, M., 2011. Evaluating one-way and two-way cluster-robust covariance matrix estimates, German Stata Users Group Meeting, July 2011.

Bebbington, A., 1996. Organizations and intensifications: Campesino federations, rural livelihoods and agricultural technology in the Andes and Amazonia. World Development 24 (7), 1161-1177.

Becker, S.O. and Ichino, A., 2002. Estimation of average treatment effects based on propensity scores. The stata journal 2 (4), 358-377.

Belay, K., 2003. Constraints to agricultural extension work in Ethiopia: the insiders' view. South African Journal of Agricultural Extension 31 (1), 63-79.

Belay, K. and Abebaw, D., 2004. Challenges facing agricultural extension agents: A case study from South-western Ethiopia. African Development Review 16 (1), 139-168.

Bellemare, M.F., 2010. Agricultural extension and imperfect supervision in contract farming: evidence from Madagascar. Agricultural Economics 41 (6), 507-517.

Ben-Akiva, M. and Lerman, S., 1985. Discrete choice analysis: theory and application to travel demand, 9. MIT press.

Bernard, T., Taffesse, A.S. and Gabre-Madhin, E., 2008. Impact of cooperatives on smallholders' commercialization behavior: evidence from Ethiopia. Agricultural Economics 39 (2), 147-161.

Besley, T. and Case, A., 1993. Modeling technology adoption in developing countries. The American Economic Review, 396-402.

Beynon, J., Jones, S. and Yao, S., 1992. Market reform and private trade in Eastern and Southern Africa. Food Policy 17 (6), 399-408.

Bielza, M., Garrido, A. and Sumpsi, J.M., 2007. Feasibility of a cash forward contract: an application to the French and Spanish potato sectors. Agribusiness 23 (2), 245-261.

Biggs, S.D., 1990. A multiple source of innovation model of agricultural research and technology promotion. World Development 18 (11), 1481-1499.

Biglaiser, G. and Friedman, J.W., 1999. Adverse selection with competitive inspection. Journal of Economics & Management Strategy 8 (1), 1-32.

Bijman, J., 2008. Contract farming in developing countries: An overview. Working Paper, Wageningen University.

Bijman, J. and Wollni, M., 2009. Producer organizations and vertical coordination. An economic organization theory perspective. In: H.J. Rosner and M. Schulz-Nieswandt (Eds.), Beitr¨age der genossenschaftlichen selbsthilfe zurwirtschaftlichen und sozialen entwicklung [Contributions of the cooperative self-help to economic and social development]. LIT Verlag, Berlin,231–252.

Bishaw, Z. and Turner, M., 2008. Linking participatory plant breeding to the seed supply system. Euphytica 163 (1), 31-44.

Bogetoft, P. and Olesen, H.B., 2002. Ten rules of thumb in contract design: lessons from Danish agriculture. European Review of Agricultural Economics 29 (2), 185-204.

Bryson, A., Dorsett, R. and Purdon, S., 2002. The use of propensity score matching in the evaluation of active labour market policies. Working Paper No. 4, Department for Work and Pensions.

Byerlee, D.R., Spielman, D.J., Alemu, D. and Gautam, M., 2007. Policies to promote cereal intensification in Ethiopia: A review of evidence and experience.

Caliendo, M. and Kopeinig, S., 2008. Some practical guidance for the implementation of propensity score matching. Journal of economic surveys 22 (1), 31-72.

Cameron, L.A., 1999. The importance of learning in the adoption of high-yielding variety seeds. American Journal of Agricultural Economics 81 (1), 83-94.

Cavatassi, R., Lipper, L. and Narloch, U., 2011. Modern variety adoption and risk management in drought prone areas: insights from the sorghum farmers of eastern Ethiopia. Agricultural Economics 42 (3), 279-292.

Ceccarelli, S. and Grando, S., 2007. Decentralized-participatory plant breeding: an example of demand driven research. Euphytica 155 (3), 349-360.

Chakraborty, S., Chakraborty, N. and Datta, A., 2000. Increased nutritive value of transgenic potato by expressing a nonallergenic seed albumin gene from Amaranthus hypochondriacus. Proceedings of the National Academy of Sciences 97 (7), 3724.

Chang, J.B., Moon, W. and Balasubramanian, S.K., 2012. Consumer valuation of health attributes for soy-based food: A choice modeling approach. Food Policy 37 (3), 335-342.

Chavas, J.-P. and Holt, M.T., 1996. Economic behavior under uncertainty: A joint analysis of risk preferences and technology. The Review of Economics and Statistics, 329-335.

Coase, R.H., 1937. The nature of the firm. Economica 4 (16), 386-405.

Colombo, S., Hanley, N. and Calatrava-Requena, J., 2005. Designing policy for reducing the off-farm effects of soil erosion using choice experiments. Journal of Agricultural Economics 56 (1), 81-95.

Conley, T. and Christopher, U., 2001. Social learning through networks: The adoption of new agricultural technologies in Ghana. American Journal of Agricultural Economics 83 (3), 668-673.

Cornell, B. and Welch, I., 1996. Culture, information, and screening discrimination. Journal of Political Economy, 542-571.

Dadi, L., Burton, M. and Ozanne, A., 2004. Duration analysis of technological adoption in Ethiopian agriculture. Journal of Agricultural Economics 55 (3), 613-631.

Davis, L.E. and North, D.C., 1971. Institutional change and American economic growth. Cambridge University Press.

Dehejia, R.H. and Wahba, S., 2002. Propensity score-matching methods for nonexperimental causal studies. Review of Economics and Statistics 84 (1), 151-161.

Deininger, K., 2003. Land policies for growth and poverty reduction. The World Bank, Washington, DC.

Delgado, C., 1999. Sources of growth in smallholder agriculture in Sub-Saharan Africa: The role of vertical integration of smallholders with processors and marketers of high value-added items. Agrekon 38, 165-189.

Delpierre, M., 2009. Farm input Use in a Context of liquidity Constraints and Contract Unenforceability. Journal of African Economies 18 (3), 496-528.

Dhar, R., 1997. Consumer preference for a no-choice option. Journal of Consumer Research 24 (2), 215-231.

Digal, L.N., 2005. Quality grading in the supply chain. Journal of International Food & Agribusiness Marketing 17 (1), 71-93.

Dixit, A., 2009. Governance institutions and economic activity. The American Economic Review, 3-24.

Doney, P.M. and Cannon, J.P., 1997. An examination of the nature of trust in buyer-seller relationships. the Journal of Marketing, 35-51.

Dorward, A., Kydd, J., Morrison, J. and Urey, I., 2004. A policy agenda for pro-poor agricultural growth. World Development 32 (1), 73-89.

Drechsel, P., Olaleye, A., Adeoti, A., Thiombiano, L., Barry, B. and Vohland, K., 2005. Adoption driver and constraints of resource conservation technologies in sub-saharan Africa. Berlin: FAO, IWMI, Humbold Universitaet.

Dyer, J.H., 1997. Effective interfirm collaboration: How firms minimize transaction costs and maximize transaction value. Strategic management journal 18 (7), 535-556.

Emana, B., Nigussie, M., 2011. Potato value chain analysis and development in Ethiopia. International Potato Center (CIP-Ethiopia), Addis Ababa, Ethiopia.

Enneking, U., Neumann, C. and Henneberg, S., 2007. How important intrinsic and extrinsic product attributes affect purchase decision. Food Quality and Preference 18 (1), 133-138.

Fafchamps, M., 1992. Cash crop production, food price volatility, and rural market integration in the third world. American Journal of Agricultural Economics 74 (1), 90-99.

Fafchamps, M., 2000. Ethnicity and credit in African manufacturing. Journal of Development economics 61 (1), 205-235.

Fafchamps, M., 2006. Development and social capital. The Journal of Development Studies 42 (7), 1180-1198.

Fafchamps, M. and Hill, R.V., 2005. Selling at the farmgate or traveling to market. American Journal of Agricultural Economics 87 (3), 717-734.

Fafchamps, M. and Minten, B., 1999. Relationships and traders in Madagascar. The Journal of Development Studies 35 (6), 1-35.

Farrington, J., 1993. Reluctant partners?: non-governmental organizations, the state and sustainable agricultural development. Routledge.

Farrington, J., 1995. The changing public role in agricultural extension. Food Policy 20 (6), 537-544.

Feder, G., Just, R.E. and Zilberman, D., 1985. Adoption of agricultural innovations in developing countries: A survey. Economic development and cultural change 33 (2), 255-298.

Feder, G. and Umali, D.L., 1993. The adoption of agricultural innovations: A review. Technological forecasting and social change 43 (3-4), 215-239.

Fehr, E., Gächter, S. and Kirchsteiger, G., 1997. Reciprocity as a contract enforcement device: Experimental evidence. Econometrica: journal of the Econometric Society, 833-860.

Feige, E.L., 1990. Defining and estimating underground and informal economies: The new institutional economics approach. World Development 18 (7), 989-1002.

Fischer, E. and Qaim, M., 2012. Linking smallholders to markets: Determinants and impacts of farmer collective action in Kenya. World Development 40 (6), 1255-1268.

Floyd, C., Harding, A.-H., Paudel, K.C., Rasali, D.P., Subedi, K. and Subedi, P.P., 2003. Household adoption and the associated impact of multiple agricultural technologies in the western hills of Nepal. Agricultural systems 76 (2), 715-738.

Gabre-Madhin, E.Z., 2001. The role of intermediaries in enhancing market efficiency in the Ethiopian grain market. Agricultural Economics 25 (2-3), 311-320.

Gadde, L. and Snehota, I., 2001. Rethinking the role of middlemen. Paper presented at the 17th Annual IMP Conference,Oslo, September.

Gagalyuk, T., Hanf, J. and Herzlieb, C., 2010. Managing supply chains successfully: An empirical testing of success of supply chain networks in the German fish sector. Food Economics–Acta Agricult Scand C 7 (2-4), 139-150.

Gebremedhin, W., 2008. Potato variety development. In: W. Gebremedhin, G. Endale and B. Lemaga (Eds.), Root and tuber crops: The untapped resources Ethiopian Institute of Agricultural Research, Addis Ababa,15-32.

Gelo, D. and Koch, S.F., 2011. Does one size fit all? Heterogeneity in the valuation of community forestry programs. Ecological Economics.

Getaneh, W. and Bekabil, F., 2008. Integrating small scale farmers into bread wheat marketing chain through contract farming in Ethiopia. Paper presented at the African Association of Agricultural Economists conference. Accra, Ghana. August.

Ghodsypour, S.H. and O'brien, C., 1998. A decision support system for supplier selection using an integrated analytic hierarchy process and linear programming. International Journal of Production Economics 56, 199-212.

Gildemacher, P.R., Demo, P., Barker, I., Kaguongo, W., Woldegiorgis, G., Wagoire, W.W., Wakahiu, M., Leeuwis, C. and Struik, P.C., 2009. A description of seed potato systems in Kenya, Uganda and Ethiopia. American Journal of Potato Research 86 (5), 373-382.

Gildemacher, P.R., Schulte-Geldermann, E., Borus, D., Demo, P., Kinyae, P., Mundia, P.C., Struik, P.C., 2011. Seed potato quality improvement through positive selection by smallholder farmers in Kenya. Potato Research 54, 253-266.

Goodhue, R.E., 2011. Food Quality: The design of incentive contracts. Annual Review of Resource Economics 3, 119-140.

Granovetter, M., 1985. Economic-action and social-structure – The problem of embeddedness. American Journal of Sociology 91 (3), 481-510.

Green, P.E. and Srinivasan, V., 1990. Conjoint analysis in marketing: new developments with implications for research and practice. the Journal of Marketing, 3-19.

Greene, W.H., 2003. Econometric analysis, 5th. Ed.. Upper Saddle River, NJ.

Grosh, B., 1994. Contract farming in Africa: An application of the new institutional economics. Journal of African Economies 3 (2), 231-261.

Guo, H., Jolly, R.W. and Zhu, J., 2005. Contract farming in China: Supply chain or ball and chain.2005.

Hackett, S.C., 1992. A comparative analysis of merchant and broker intermediation. Journal of Economic Behavior & Organization 18 (3), 299-315.

Hagenimana, V., Oyunga, M.A., Low, J., Njoroge, S., Gichuki, S.T., Kabira, J., 1999. The effects of women farmers' adoption of orange-fleshed sweet potatoes: Raising vitamin A intake in Kenya. ICRW/OMNI Research Report Series, 3 (1999), pp. 1–24.

Hagos, F., Jayasinghe, G., Awulachew, S.B., Loulseged, M. and Yilma, A.D., 2012. Agricultural water management and poverty in Ethiopia. Agricultural Economics 43, 99-111.

Hall, A., Bockett, G., Taylor, S., Sivamohan, M. and Clark, N., 2001. Why research partnerships really matter: innovation theory, institutional arrangements and implications for developing new technology for the poor. World development 29 (5), 783-797.

Hall, A., 2012. Partnerships in agricultural innovation: Who puts them together and are they enough? In: OECD (Ed.), Improving Agricultural Knowledge and Innovation Systems: OECD Conference Proceedings. OECD Publishing,219-235.

Harou, A., Walker, T., 2010. The Pineapple Market and the Role of Cooperatives. Working Paper, Cornell University.

Hayami, Y., 1996. The peasant in economic modernization. American Journal of Agricultural Economics 78 (5), 1157-1167.

He, X.F., Cao, H. and Li, F.M., 2007. Econometric analysis of the determinants of adoption of rainwater harvesting and supplementary irrigation technology (RHSIT) in the semiarid Loess Plateau of China. Agricultural water management 89 (3), 243-250.

Heckman, J.J., Ichimura, H. and Todd, P.E., 1997. Matching as an econometric evaluation estimator: Evidence from evaluating a job training programme. The review of economic studies 64 (4), 605-654.

Heckman, J.J., Ichimura, H. and Todd, P.E., 1998. Matching as an econometric evaluation estimator. The review of economic studies 65 (2), 261-294.

Heckman, J.J., LaLonde, R.J. and Smith, J.A., 1999. The economics and econometrics of active labor market programs. Handbook of labor economics 3, 1865-2097.

Henson, S. and Jaffee, S., 2008. Understanding developing country strategic responses to the enhancement of food safety standards. The World Economy 31 (4), 548-568.

Henson, S., Masakure, O. and Boselie, D., 2005. Private food safety and quality standards for fresh produce exporters: The case of Hortico Agrisystems, Zimbabwe. Food Policy 30 (4), 371-384.

Herath, D. and Weersink, A., 2009. From plantations to smallholder production: the role of policy in the reorganization of the Sri Lankan tea sector. World Development 37 (11), 1759-1772.

Hernández, R., Reardon, T. and Berdegué, J., 2007. Supermarkets, wholesalers, and tomato growers in Guatemala. Agricultural Economics 36 (3), 281-290.

Hirpa, A., Meuwissen, M.P.M., Tesfaye, A., Lommen, W.J.M., Lansink, A.O., Tsegaye, A. and Struik, P.C., 2010. Analysis of seed potato systems in Ethiopia. American journal of potato research 87 (6), 537-552.

Hirpa, A., Meuwissen, M.P.M., Van der Lans, I.A., Lommen, W.J.M., Oude Lansink, A.G.J.M., Tsegaye, A. and Struik, P.C., 2012. Farmers' opinion on seed potato management attributes in Ethiopia: A conjoint analysis. Agronomy Journal 104 (5), 1413-1424.

Hobbs, J.E., 1996. A transaction cost approach to supply chain management. Supply Chain Management: An International Journal 1 (2), 15-27.

Hodge, G.A. and Greve, C., 2009. PPPs: The passage of time permits a sober reflection. Economic Affairs 29 (1), 33-39.

Hoffman, E., McCabe, K.A. and Smith, V.L., 1998. Behavioral foundations of reciprocity: Experimental economics and evolutionary psychology. Economic Inquiry 36 (3), 335-352.

Holleran, E., Bredahl, M.E. and Zaibet, L., 1999. Private incentives for adopting food safety and quality assurance. Food Policy 24 (6), 669-683.

Holloway, G., Nicholson, C., Delgado, C., Staal, S. and Ehui, S., 2008. Agroindustrialization through institutional innovation Transaction costs, cooperatives and milk-market development in the east-African highlands. Agricultural Economics 23 (3), 279-288.

Howard, H., 1974. Factors influencing the quality of ware potatoes. 1. The genotype. Potato Research 17 (4), 490-511.

Hueth, B. and Ligon, E., 1999. Producer price risk and quality measurement. American Journal of Agricultural Economics 81 (3), 512-524.

Hueth, B., Ligon, E., Wolf, S. and Wu, S., 1999. Incentive instruments in fruit and vegetable contracts: input control, monitoring, measuring, and price risk. Review of agricultural economics 21 (2), 374-389.

Humphrey, J. and Schmitz, H., 1998. Trust and inter-firm relations in developing and transition economies. The Journal of Development Studies 34 (4), 32-61.

Jaffe, S., Henson, S. and Diaz Rios, L., 2011. Making the grade-smallholder farmers, emerging standards, and development assistance programs in Africa-a research program synthesis.

Jaleta, M. and Gardebroek, C., 2007. Farm-gate tomato price negotiations under asymmetric information. Agricultural Economics 36 (2), 245-251.

Jang, J. and Olson, F., 2010. The role of product differentiation for contract choice in the agro-food sector. European Review of Agricultural Economics 37 (2), 251-273.

Jemison, J.M., Sexton, P. and Camire, M.E., 2008. Factors influencing consumer preference of fresh potato varieties in Maine. American journal of potato research 85 (2), 140-149.

Jones, M.A., Reynolds, K.E., Mothersbaugh, D.L. and Beatty, S.E., 2007. The positive and negative effects of switching costs on relational outcomes. Journal of Service Research 9 (4), 335-355.

Just, R.E. and Zilberman, D., 1983. Stochastic structure, farm size and technology adoption in developing agriculture. Oxford economic papers 35 (2), 307-328.

Kafle, B. and Shah, P., 2012. Adoption of improved potato varieties In Nepal: A case of Bara district. Journal of Agricultural Sciences 7 (1), 14-22.

Kanda, A. and Deshmukh, S., 2008. Supply chain coordination: Perspectives, empirical studies and research directions. International Journal of Production Economics 115 (2), 316-335.

Kassie, M., Shiferaw, B. and Muricho, G., 2011. Agricultural technology, crop income, and poverty alleviation in Uganda. World Development 39 (10), 1784-1795.

Key, N. and McBride, W., 2003. Production contracts and productivity in the US hog sector. American Journal of Agricultural Economics 85 (1), 121-133.

Key, N. and Runsten, D., 1999. Contract farming, smallholders, and rural development in Latin America: the organization of agroprocessing firms and the scale of outgrower production. World Development 27 (2), 381-401.

Khandker, S.R., Koolwal, G.B. and Samad, H.A., 2010. Handbook on impact evaluation: quantitative methods and practices. World Bank Washington, DC.

Kherallah, M. and Kirsten, J.F., 2002. The new institutional economics: applications for agricultural policy research in developing countries. Agrekon 41 (2), 110-133.

King, R.P., Backus, G.B.C. and Van der Gaag, M.A., 2007. Incentive systems for food quality control with repeated deliveries: Salmonella control in pork production. European Review of Agricultural Economics 34 (1), 81-104.

Kirsten, J. and Sartorius, K., 2002. Linking agribusiness and small-scale farmers in developing countries: is there a new role for contract farming? Development Southern Africa 19 (4), 503-529.

Klerkx, L. and Leeuwis, C., 2008. Matching demand and supply in the agricultural knowledge infrastructure: Experiences with innovation intermediaries. Food Policy 33 (3), 260-276.

Koundouri, P., Nauges, C. and Tzouvelekas, V., 2006. Technology adoption under production uncertainty: Theory and application to irrigation technology. American Journal of Agricultural Economics 88 (3), 657-670.

Lajili, K., Barry, P.J., Sonka, S.T. and Mahoney, J.T., 1997. Farmers' preferences for crop contracts. Journal of Agricultural and Resource Economics, 264-280.

Lancaster, K.J., 1966. A new approach to consumer theory. The journal of political economy 74 (2), 132-157.

Landa, J.T., 1981. Theory of the ethically homogeneous middleman group: An institutional alternative to contract law, A. J. Legal Stud. 10, 349.

Lechner, M., 2001. A note on the common support problem in applied evaluation studies. Discussion Paper No. 2001-01, University of St Gallen, SIAW.

Lechner, M., 2002. Some practical issues in the evaluation of heterogeneous labour market programmes by matching methods. Journal of the Royal Statistical Society: Series A (Statistics in Society) 165 (1), 59-82.

Lee, H.L., Padmanabhan, V. and Whang, S., 1997. Information distortion in a supply chain: the bullwhip effect. Management science 43 (4), 546-558.

LeRoux, M.N., Schmit, T.M., Roth, M. and Streeter, D.H., 2010. Evaluating marketing channel options for small-scale fruit and vegetable producers. Renewable agriculture and food systems 25 (1), 16.

Leeuwis, C., Van den Ban, A., 2004. Communication for rural innovation: rethinking agricultural extension. Blackwell Science, Oxford.

Leuven, E. and Sianesi, B., 2012. PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing. Accessed at http://ideas.repec.org/c/boc/bocode/s432001.html.

Levin, J., 2003. Relational incentive contracts. The American Economic Review 93 (3), 835-857.

Li, T.M., 2011. Centering labor in the land grab debate. The Journal of Peasant Studies 38 (2), 281-298.

Li, Y., 1998. Middlemen and private information. Journal of Monetary Economics 42 (1), 131-159.

Little, P.D. and Watts, M., 1994. Contract farming and the development question. Living under contract: contract farming and agrarian transformation in sub-Saharan Africa., 216-247.

Long, C.M., Snapp, S.S., Douches, D.S. and Chase, R.W., 2004. Tuber yield, storability, and quality of Michigan cultivars in response to nitrogen management and seedpiece spacing. American journal of potato research 81 (5), 347-357.

Luning, P.A., Marcelis, W.J. and Jongen, W.M.F., 2002. Food quality management: a techno-managerial approach. Wageningen Pers.

Malone, T.W. and Crowston, K., 1994. The interdisciplinary study of coordination. ACM Computing Surveys (CSUR) 26 (1), 87-119.

Mariano, M.J., Villano, R. and Fleming, E., 2012. Factors influencing farmers' adoption of modern rice technologies and good management practices in the Philippines. Agricultural systems 110 (0), 41-53.

Masakure, O. and Henson, S., 2005. Why do small-scale producers choose to produce under contract? Lessons from nontraditional vegetable exports from Zimbabwe. World Development 33 (10), 1721-1733.

Masten, S.E., 2000. Transaction-cost economics and the organization of agricultural transactions. Advances in Applied Microeconomics 9, 173-195.

Masters, A., 2008. Unpleasant middlemen. Journal of Economic Behavior & Organization 68 (1), 73-86.

Masuku, M.B. and Kirsten, J.F., 2004. The role of trust in the performance of supply chains: A dyad analysis of smallholder farmers and processing firms in the sugar industry in Swaziland. Agrekon 43 (2), 147-161.

McFadden, D., 1974. Conditional logit analysis of qualitative choice behavior. In: P. Zarembka (Ed.), Frontiers in Econometrics. Academic Press. Academic Press, New York,105-142.

McMillan, J. and Woodruff, C., 1999. Private order under dysfunctional public order. Mich. L. Rev. 98, 2421.

Ménard, C., 2004. The economics of hybrid organizations. Journal of Institutional and Theoretical Economics (JITE)/Zeitschrift für die gesamte Staatswissenschaft, 345-376.

Ménard, C. and Valceschini, E., 2005. New institutions for governing the agri-food industry. European Review of Agricultural Economics 32 (3), 421-440.

Michelson, H., Reardon, T. and Perez, F., 2011. Small farmers and big retail: trade-offs of supplying supermarkets in Nicaragua. World Development 40 (2), 342–354.

Minot, N., 2011. Contract farming in sub-Saharan Africa: Opportunities and challenges. Prepared for the policy seminar organized by ACTESA-MSU-IFPRI African Agricultural Markets Programme. Kigali, Rwanda. April.

Minten, B., Randrianarison, L. and Swinnen, J.F., 2009. Global retail chains and poor farmers: Evidence from Madagascar. World Development 37 (11), 1728-1741.

Minten, B., Vandeplas, A., Ghorpade, Y. and Swinnen, J.F.M., 2010. Horticulture wholesale trade and governance in India: Evidence from Uttarakhand. Journal of South Asian Development 5 (1), 113-136.

Mittal, S., Gandhi, S. and Tripathi, G., 2010. Socio-economic impact of mobile phones on Indian Agriculture. Indian Council for Research on International Economic Relations New Delhi.

Miyata, S., Minot, N. and Hu, D., 2009. Impact of contract farming on income: Linking small farmers, packers, and supermarkets in China. World Development 37 (11), 1781-1790.

Monson, J., Mainville, D. and Kuminoff, N., 2008. The decision to direct market: an analysis of small fruit and specialty-product markets in Virginia. Journal of Food Distribution Research 39 (2), 1-11.

Moore, M., 1997. Societies, polities and capitalists in developing countries: A literature survey. The Journal of Development Studies 33 (3), 287-363.

Moser, C.M. and Barrett, C.B., 2006. The complex dynamics of smallholder technology adoption: The case of SRI in Madagascar. Agricultural Economics 35 (3), 373-388.

Moustier, P., Tam, P.T.G., Binh, V.T. and Loc, N.T.T., 2010. The role of farmer organizations in supplying supermarkets with quality food in Vietnam. Food Policy 35 (1), 69-78.

Mulatu, E., Ibrahim, O.E. and Bekele, E., 2005. Improving potato seed tuber quality and producers' livelihoods in Hararghe, Eastern Ethiopia. Journal of New Seeds 7 (3), 31-56.

Muto, M. and Yamano, T., 2009. The impact of mobile phone coverage expansion on market participation: Panel data evidence from Uganda. World Development 37 (12), 1887-1896.

Nabli, M.K. and Nugent, J.B., 1989. The new institutional economics and its applicability to development. World Development 17 (9), 1333-1347.

Narrod, C., Roy, D., Okello, J., Avendaño, B., Rich, K. and Thorat, A., 2009. Public–private partnerships and collective action in high value fruit and vegetable supply chains. Food Policy 34 (1), 8-15.

Neven, D., Odera, M.M., Reardon, T. and Wang, H., 2009. Kenyan supermarkets, emerging middle-class horticultural farmers, and employment impacts on the rural poor. World Development 37 (11), 1802-1811.

Nichols, A., 2011. Causal inference for binary regression, Stata Conference Chicago (version June 14, 2011).

Nohria, N. and Gulati, R., 1996. Is slack good or bad for innovation? Academy of Management Journal 39 (5), 1245-1264.

Nooteboom, B., 2007. Social capital, institutions and trust. Review of Social Economy 65 (1), 29-53.

North, D.C., 1990. A transaction cost theory of politics. Journal of Theoretical Politics 2 (4), 355-367.

North, D.C., 1994. Economic performance through time. The American Economic Review 84 (3), 359-368.

Nunn, N. and Qian, N., 2011. The potato's contribution to population and urbanization: Evidence from a historical experiment. The Quarterly Journal of Economics 126 (2), 593-650.

Ortiz, O., Orrego, R., Pradel, W., Gildemacher, P., Castillo, R., Otiniano, R., Gabriel, J., Vallejo, J., Torres, O., Woldegiorgis, G., 2011. Incentives and disincentives for stakeholder involvement in participatory research (PR): lessons from potato-related PR from Bolivia, Ethiopia, Peru and Uganda. International Journal of Agricultural Sustainability 9, 522-536.

Ortiz, O., Orrego, R., Pradel, W., Gildemacher, P., Castillo, R., Otiniano, R., Gabriel, J., Vallejo, J., Torres, O. and Woldegiorgis, G., 2013. Insights into potato innovation systems in Bolivia, Ethiopia, Peru and Uganda. Agricultural systems 114, 73-83.

Oya, C., 2012. Contract farming in Sub-Saharan Africa: A survey of approaches, debates and issues. Journal of Agrarian Change 12 (1), 1-33.

Pascucci, S. and de-Magistris, T., 2011. The effects of changing regional agricultural knowledge and innovation system on Italian farmers' strategies. Agricultural systems 104 (9), 746-754.

Pedroza, C., 2013. Middlemen, informal trading and its linkages with IUU fishing activities in the port of Progreso, Mexico. Marine Policy 39 (0), 135-143.

Platteau, J.-P., 2000. Institutions, social norms and economic development, 1. Routledge.

Platteau, J.P., 1994. Behind the market stage where real societies exist-part I: The role of public and private order institutions. The Journal of Development Studies 30 (3), 533-577.

Poole, N.D., Del Campo Gomis, F.J., Juliá Igual, J.F. and Vidal Giménez, F., 1998. Formal contracts in fresh produce markets. Food Policy 23 (2), 131-142.

Poppo, L. and Zenger, T., 2002. Do formal contracts and relational governance function as substitutes or complements? Strategic management journal 23 (8), 707-725.

Porter, G. and PhillipsHoward, K., 1997. Comparing contracts: An evaluation of contract farming schemes in Africa. World Development 25 (2), 227-238.

Poulton, C., Dorward, A. and Kydd, J., 1998. The revival of smallholder cash crops in Africa: public and private roles in the provision of finance. Journal of International Development 10 (1), 85-103.

Poulton, C., Dorward, A. and Kydd, J., 2010. The future of small farms: New directions for services, institutions, and intermediation. World Development 38 (10), 1413-1428.

Poulton, C., Kydd, J. and Dorward, A., 2006. Overcoming market constraints on pro-poor agricultural growth in Sub-Saharan Africa. Development Policy Review 24 (3), 243-277.

Poulton, C. and Macartney, J., 2012. Can public–private partnerships leverage private investment in agricultural value chains in Africa? A preliminary review. World Development 40 (1), 96-109.

Ransom, J., Paudyal, K. and Adhikari, K., 2003. Adoption of improved maize varieties in the hills of Nepal. Agricultural Economics 29 (3), 299-305.

Raynaud, E., Sauvee, L. and Valceschini, E., 2005. Alignment between quality enforcement devices and governance structures in the agro-food vertical chains. Journal of Management and Governance 9 (1), 47-77.

Reardon, T., Barrett, C.B., Berdegué, J.A. and Swinnen, J.F., 2009. Agrifood industry transformation and small farmers in developing countries. World Development 37 (11), 1717-1727.

Reardon, T. and Swinnen, J.F., 2004. Agrifood sector liberalisation and the rise of supermarkets in former state-controlled economies: A comparative overview. Development Policy Review 22 (5), 515-523.

Rehber, E., 1998. Vertical integration in agriculture and contract farming. Regional Research Project NE-165: Private strategies, public policies, and food system performance, University of Massachusetts, Department of Resource Economics, Amherst, MA 1003.

Rivera, W.M., 2008. Pathways and tensions in the family of reform. Journal of Agricultural Education and Extension 14 (2), 101-109.

Rivera, W.M., Qamar, M.K. and Mwandemere, H.K., 2005. Enhancing coordination among AKIS/RD actors: An analytical and comparative review of country studies on agricultural knowledge and information systems for rural development (AKIS/RD). FAO, Rome, Italy.

Rivers, D. and Vuong, Q.H., 1988. Limited information estimators and exogeneity tests for simultaneous probit models. Journal of econometrics 39 (3), 347-366.

Rizvi, S., Sharma, R., Srinivas, T., Manan, A., Osmanzai, A., Siddiqui, S., Wadan, K., Hakimi, N. and Rahmani, A., 2012. Comparative evaluation of local and improved crop

varieties through farmers' participation on resource-poor farms in Afghanistan. Acta Agronomica Hungarica 60 (1), 11-20.

Rogers, E.M., 1995. Diffusion of innovations. Free Pr.

Rosenbaum, P.R., 2002. Observational studies. Springer: New York.

Rosenbaum, P.R. and Rubin, D.B., 1985. Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. The American Statistician 39 (1), 33-38.

Ruben, R. and Heras, J., 2012. Social capital, governance and performance of Ethiopian coffee cooperatives. Annals of Public and Cooperative Economics 83 (4), 463-484.

Ruben, R., Van Boekel, M. and Van Tilburg, A., 2007. Tropical food chains: governance regimes for quality management. Wageningen Academic Pub: Wageningen.

Rubin, D.B. and Thomas, N., 1996. Matching using estimated propensity scores: relating theory to practice. Biometrics, 249-264.

Rubinstein, A. and Wolinsky, A., 1987. Middlemen. The Quarterly Journal of Economics 102 (3), 581-593.

Ruto, E. and Garrod, G., 2009. Investigating farmers' preferences for the design of agri-environment schemes: a choice experiment approach. Journal of Environmental Planning and Management 52 (5), 631-647.

Saha, A., Love, H.A. and Schwart, R., 1994. Adoption of emerging technologies under output uncertainty. American Journal of Agricultural Economics, 836-846.

Sall, S., Norman, D. and Featherstone, A.M., 2000. Quantitative assessment of improved rice variety adoption: the farmer's perspective. Agricultural systems 66 (2), 129-144.

Sartorius, K. and Kirsten, J., 2007. A framework to facilitate institutional arrangements for smallholder supply in developing countries: an agribusiness perspective. Food Policy 32 (5), 640-655.

Sawyer, R. and Dallyn, S., 1964. Internal sprouting of potatoes. American journal of potato research 41 (2), 59-69.

Schipmann, C. and Qaim, M., 2010. Spillovers from modern supply chains to traditional markets: product innovation and adoption by smallholders. Agricultural Economics 41 (3-4), 361-371.

Schulte-Geldermann, E., Gildemacher, P. and Struik, P.C., 2012. Improving seed health and seed performance by positive selection in three Kenyan potato varieties. American journal of potato research, 1-9.

Scott, C., 1984. Transnational corporations and asymmetries in the Latin American food system. Bulletin of Latin American Research 3 (1), 63-80.

Scott, G.J., 1985. Markets, myths, and middlemen: a study of potato marketing in central Peru. International Potato Center.

Sen, D., Rakshit, A., Sarkar, N.C., Ghosh, D.C. and Bardhan Roy, S.K., 2010. Effect of transplanting dates and spacing on yield attributing character, productivity and economics of potato cultivation through true potato seed (TPS) technology. Italian Journal of Agronomy 5 (1), 35-42.

Serageldin, I., 1999. Biotechnology and food security in the 21st century. Science 285 (5426), 387-389.

Sheldon, M.R., Fillyaw, M.J. and Thompson, W.D., 1996. The use and interpretation of the Friedman test in the analysis of ordinal-scale data in repeated measures designs. Physiotherapy Research International 1 (4), 221-228.

Sianesi, B., 2004. An evaluation of the Swedish system of active labor market programs in the 1990s. Review of Economics and Statistics 86 (1), 133-155.

Singh, S., 2002. Contracting out solutions: Political economy of contract farming in the Indian Punjab. World Development 30 (9), 1621-1638.

Sinuany-Stern, Z., Mehrez, A. and Hadad, Y., 2000. An AHP/DEA methodology for ranking decision making units. International Transactions in Operational Research 7 (2), 109-124.

Sloof, M., Tijskens, L. and Wilkinson, E., 1996. Concepts for modelling the quality of perishable products. Trends in Food Science & Technology 7 (5), 165-171.

Smale, M., Just, R.E. and Leathers, H.D., 1994. Land allocation in HYV adoption models: an investigation of alternative explanations. American Journal of Agricultural Economics 76 (3), 535-546.

Smit, N., Odongo, B., 1997. Integrated pest management for sweetpotato in East Africa, Program Report 1995–1996. CIP, Lima, Peru, pp. 191-197.

Smith, J.A. and Todd, P.E., 2001. Reconciling conflicting evidence on the performance of propensity-score matching methods. The American Economic Review 91 (2), 112-118.

Smith, J.A. and Todd, P.E., 2005. Does matching overcome LaLonde's critique of nonexperimental estimators? Journal of econometrics 125 (1), 305-353.

Smits, R., Kuhlmann, S., 2004. The rise of systemic instruments in innovation policy. International Journal of Foresight and Innovation Policy 1 (1/2), 4–30.

Sperling, L., Ashby, J.A., Smith, M.E., Weltzien, E. and McGuire, S., 2001. A framework for analyzing participatory plant breeding approaches and results. Euphytica 122 (3), 439-450.

Spielman, D.J., Byerlee, D., Alemu, D. and Kelemework, D., 2010. Policies to promote cereal intensification in Ethiopia: The search for appropriate public and private roles. Food Policy 35 (3), 185-194.

Spielman, D.J., Davis, K., Negash, M. and Ayele, G., 2011. Rural innovation systems and networks: findings from a study of Ethiopian smallholders. Agriculture and Human Values 28 (2), 195-212.

Spinelli, S. and Birley, S., 2002. An empirical evaluation of conflict in the franchise system. British Journal of Management 9 (4), 301-325.

Staal, S., Delgado, C. and Nicholson, C., 1997. Smallholder dairying under transactions costs in East Africa. World Development 25 (5), 779-794.

Stank, T.P., Crum, M.R. and Arango, M., 1999. Benefits of interfirm coordination in food industry supply chains. Journal of business logistics.

Steenkamp, J.B.E.M., 1989. Product quality: An investigation into the concept and how it is perceived by consumers. Van Gorcum AssenMaastrich.

Stewart, H., Blisard, N., Bhuyan, S. and Nayga Jr, R.M., 2004. The demand for food away from home: full service or fast food. USDA-Economic Research Service Report No. 829. USDA-Economic Research Service: Washington, DC.

Storey, R. and Davies, H., 1992. Tuber quality. In: P. Harris (Ed.), The potato crop. Chapman and Hall, London,507-569.

Street, D.J., Burgess, L. and Louviere, J.J., 2005. Quick and easy choice sets: constructing optimal and nearly optimal stated choice experiments. International Journal of Research in Marketing 22 (4), 459-470.

Sumberg, J., 2005. Systems of innovation theory and the changing architecture of agricultural research in Africa. Food Policy 30 (1), 21-41.

Sumberg, J., Okali, C. and Reece, D., 2003. Agricultural research in the face of diversity, local knowledge and the participation imperative: theoretical considerations. Agricultural systems 76 (2), 739-753.

Swinnen, J.F. and Maertens, M., 2007. Globalization, privatization, and vertical coordination in food value chains in developing and transition countries. Agricultural Economics 37, 89-102.

Sykuta and Parcell, J., 2003. Contract structure and design in identity-preserved soybean production. Review of agricultural economics 25 (2), 332-350.

Tadesse, G. and Guttormsen, A.G., 2010. The behavior of commodity prices in Ethiopia. Agricultural Economics 42 (1), 87-97.

Tefera, T.L., Sehai, E., Hoekstra, D., 2011. Status and capacity of farmer training centers (FTCs) in the improving productivity and market success (IPMS) pilot learning Woredas (PLWs). International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia.

Tepic, M., 2012. Innovation capabilities and governance in the Agr-Food Sector. PhD Thesis, Wageningen University.

Tesfaye, A. and Brouwer, R., 2011. Testing participation constraints in contract design for sustainable soil conservation in Ethiopia. Ecological Economics.

Tesfaye, A.B., Bedane, K., Yirga, C. and Gebremedhin, W., 2008. Socioeconomics and technology transfer. In: W. Gebremedhin, G. Endale and B. Lemaga (Eds.), Root and tuber crops: The untapped resources. Ethiopian Institute of Agricultural Research, Addis Abeba,131–152.

Thangata, P.H. and Alavalapati, J.R.R., 2003. Agroforestry adoption in southern Malawi: the case of mixed intercropping of Gliricidia sepium and maize. Agricultural systems 78 (1), 57-71.

Thiele, G., 1999. Informal potato seed systems in the Andes: Why are they important and what should we do with them? World Development 27 (1), 83-99.

Thiele, G., van de Fliert, E., Campilan, D., 2001. What happened to participatory research at the International Potato Center? Agriculture and Human Values 18, 429-446.

Thompson, J. and Scoones, I., 2009. Addressing the dynamics of agri-food systems: an emerging agenda for social science research. Environmental science & policy 12 (4), 386-397.

Tomlins, K., Rwiza, E., Nyango, A., Amour, R., Ngendello, T., Kapinga, R., Rees, D., Jolliffe, F., 2004. The use of sensory evaluation and consumer preference for the selection of sweetpotato cultivars in East Africa. Journal of the Science of Food and Agriculture 84, 791-799.

Townsend, R.M., 1978. Intermediation with costly bilateral exchange. The review of economic studies, 417-425.

Train, K.E., 2003. Discrete choice methods with simulation. Cambridge university press.

Tripathi, R., Singh, R. and Singh, S., 2005. Contract farming in potato production: An alternative for managing risk and uncertainty. Agricultural Economics Research Review 18 (2005).

Uematsu, H. and Mishra, A.K., 2012. Organic farmers or conventional farmers: Where's the money? Ecological Economics 78, 55-62.

Umali-Deininger, D., 1997. Public and private agricultural extension: Partners or rivals? The World Bank Research Observer 12 (2), 203-224.

van Rijn, F., Bulte, E. and Adekunle, A., 2012. Social capital and agricultural innovation in Sub-Saharan Africa. Agricultural systems 108, 112-122.

Vermeulen, H., Kirsten, J. and Sartorius, K., 2008. Contracting arrangements in agribusiness procurement practices in South Africa. Agrekon 47 (2), 198-221.

Wakeyo, M.B. and Gardebroek, C., 2013. Does water harvesting induce fertilizer use among smallholders? Evidence from Ethiopia. Agricultural systems 114 (0), 54-63.

Waller, B.E., W. Hoy, C., Henderson, J.L., Stinner, B. and Welty, C., 1998. Matching innovations with potential users, a case study of potato IPM practices. Agriculture, Ecosystems and Environment 70 (2-3), 203-215.

Wang, H.H., Zhang, Y. and Wu, L., 2011. Is contract farming a risk management instrument for Chinese farmers?: Evidence from a survey of vegetable farmers in Shandong. China Agricultural Economic Review 3 (4), 489-505.

Weatherspoon, D.D. and Reardon, T., 2003. The rise of supermarkets in Africa: implications for agrifood systems and the rural poor. Development Policy Review 21 (3), 333-355.

Weissleder, L., 2009. Foreign direct investment in the agricultural sector in Ethiopia. Ecofair Trade Dialogue Discussion Papers No. 12.

Wever, M., 2012. Chain-wide consequences of transaction risks and their contractual solutions: Managing interdependencies in differentiated agri-food supply chains. PhD Thesis, Wageningen University.

Williamson, E.O., 1985. The economic institutions of capitalism: Firms, markets, relational contracting. Free Press: New York.

Williamson, O.E., 1979. Transaction-cost economics: the governance of contractual relations. Journal of law and economics 22 (2), 233-261.

Williamson, O.E., 1998. The institutions of governance. The American Economic Review 88 (2), 75-79.

Williamson, O.E., 1999. Strategy research: governance and competence perspectives. Strategic management journal 20 (12), 1087-1108.

Williamson, O.E., 2000. The new institutional economics: taking stock, looking ahead. Journal of economic literature, 595-613.

Wilson, J., 1986. The political economy of contract farming. Review of Radical Political Economics 18 (4), 47-70.

Wolf, S., Hueth, B. and Ligon, E., 2001. Policing mechanisms in agricultural contracts. Rural Sociology 66 (3), 359-381.

Wollni, M. and Zeller, M., 2007. Do farmers benefit from participating in specialty markets and cooperatives? The case of coffee marketing in Costa Rica. Agricultural Economics 37 (2-3), 243-248.

Wong, A., 1999. Partnering through cooperative goals in supply chain relationships. Total Quality Management 10 (4-5), 786-792.

World Bank, 2008. World Development Report 2008, Washington, DC.

Zinnah, M., Lin Compton, J. and Adesina, A., 1993. Research-extension-farmer linkages within the context of the generation, transfer and adoption of improved mangrove swamp rice technology in West Africa. Quarterly Journal of International Agriculture 32, 201-201.

About the author

Gumataw Kifle Abebe (MBA, Leipzig Graduate School of Management, Germany) is a PhD candidate at the Management Studies Group of Wageningen University. He joined Wageningen University in October 2008 under the research programme 'Co-Innovation for Quality in African Food Chains, CoQA', which is a collaboration of Wageningen University with Hawassa University and Addis Ababa University in Ethiopia, University of Abomey-Calavi (Benin) and the University of Fort Hare (South Africa). Within the CoQA framework, his study focuses on analyzing coordination mechanisms on quality improvement and market access in the context of Ethiopian potato value chains. The main contribution of his PhD work is on creating knowledge for the development of sustainable supply chains in Ethiopia by analyzing smallholder farmers' constraints to improve quality and market access and evaluating possible coordination mechanisms. Before pursuing his PhD study, he worked at Hawassa University at various positions: as a lecturer in the Department of Management, as head of the Department of Procurement and Property Administration of the University, and as Development and Administration head of the College of Health Sciences. His research interests are mainly in the area of development economics, such as on the role of institutions, value chain analysis, and contract farming arrangement.

Gumataw Kifle Abebe

PhD candidate, Wageningen School of Social Sciences (WASS)

Completed Training and Supervision Plan

Name of the activity	Department/Institute	Year	ECTS (=28 hrs)
A. Project related competences			
Organization of the Agribusiness (BEC 31306)	WUR	2008	6
Economic Institution of agricultural food in rural areas: Institutional Dynamics, Organization and Governance	MG3S	2009	4
Advanced Econometrics (AEP 60306)	WUR	2009	6
Advanced Supply Chain Management (ORL 31306)	WUR	2009	6
Behavioral and Experimental Economics (ECH 51306)	WUR	2013	4
International CoQA Workshop	Wageningen, Ethiopia, Benin	2009, 2010, 2011	4.2
Summer course on New Institutional Economics	ESNIE, France	2011	2
B. General research related competences			
Information Literacy for PhD including Endnote	WGS	2009	0.6
Mansholt Introduction course	MG3S	2009	1.5
Proposal Writing	WASS	2009	2
Research Methods, topic to proposal	WASS	2009	4
Experiment! A workshop on experimental methods in social science and interdisciplinary research	CERES, MG3S	2009	1.5
'The Role of potato cooperatives in Ethiopia in improving quality and transaction costs'	WASS	2010	1
Scientific Writing	WUR	2012	1.8
'Analysis of the causes of low adoption in less developed agrifood chains: the case of potato supply chain in the Upper Rift Valley Region of Ethiopia'	WiCaNeM, Wageningen	2012	1
'Geography of quality in the Ethiopian potato supply chain	ÍNREF, Wageningen	2012	1
'Middlemen in Value Chains: an Enabling or Constraining Institution?'	ISNIE, Italy	2013	1
Introduction to R for Statistical Analysis	PE&RC	2013	0.6
TOTAL			48.2

The research described in this thesis was financially supported by the Wageningen University International Research and Education Fund (INREF), through the CoQA project, and The Netherlands Organization for International Cooperation for Higher Education (NUFFIC). The content of the thesis reflects only the views of the author.

Financial support from Grant Judith Zwartz Foundation for printing this thesis is gratefully acknowledged.