Food safety standards in developing countries: Exploring the role of financial literacy

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Summary

The global agri-food system is experiencing a far-reaching transformation process. The consequences for small, asset-poor farmers are a topic of special concern in development oriented agricultural research. One main characteristic of the trend is the increasing importance of food safety and quality standards for participating in global agricultural value chains. Small farmers' market participation may be challenged through this trend, as certification requires major investments and changes in production processes. The increasing importance of standards may be on the other hand a strong incentive to upgrade production. The literature discusses exclusion and upgrading scenarios controversially. Another topic of interest is the economic impacts of the increasing standardization in agricultural value chains. Considering the described trend, the objective of the thesis is to improve the understanding of the determinants of food safety standard adoption and contribute to the knowledge on the impacts of standard adoption. The thesis is divided into four papers that all contribute to the research objective.

The first paper of the thesis introduces the cluster concept and the global value chain approach. Both concepts are widely applied to analyze organizational patterns between economic actors. Whereas cluster analysis is used to analyze the economic organization at the local level, global value chain analysis is concerned with the economic organization of globally dispersed actors connected through their vertical trade relationships. For a deeper understanding of the agri-food transformation process, it is relevant to consider horizontal and vertical organizational patterns. The paper supports the position that both concepts could be complementary when it comes to analyzing determinants of small farmers' participation in high-value markets or the effects of organizational changes in global value chains on small farmers in developing countries.

The second paper of the thesis is discussing the determinants and effects of increased standard implementation in agricultural value chains. Categorizing standard systems according to the standard setters, their scope and their objectives helps to better understand adoption determinants and economic impacts. Food safety and quality as a credence good comes with high information asymmetries within agri-food chains. The shift towards private certification systems is partly due to a general policy shift which leaves

the responsibility for food safety and quality with private actors, as the retailers for example. Standards are used as a tool for risk management and product differentiation. They are used to meet the demand of informed consumers and stakeholders and to reduce risks related to food safety. Private standard schemes are important for non-traditional agricultural exports, which have received especial political support throughout Latin America. There is still no systematic evidence on whether standards create exclusive supply chains. But there is no doubt that standards for food safety and quality will continue to play an important role in agricultural value chains.

The core of the thesis consists of two papers that analyze primary data from a random sample of small pea farmers in Guatemala. Paper three studies the determinants of Globalgap adoption in the fresh pea sector in Guatemala. The sector is characterized by small-scale farming and has a long tradition of sanitary and phytosanitary problems. Regardless of the increasing importance of food safety and quality in high value chains, the compliance with Globalgap is relatively low. The contribution of the paper to the existing literature is the consideration of farmers' financial skills in the adoption process. The study shows that apart from capital endowment and access factors, financial literacy plays a significant role in standard adoption. Farmers with a higher level of financial literacy are more likely to adopt Globalgap compared to those farmers with a lower level of financial literacy. It seems that farmers with higher skills are better able to comply with the stringent criteria of the standard which improves their adoption probability. Furthermore, the results show that formal education is not important for Globalgap adoption in the study context. Skills and knowledge necessary for standard adoption do not come from formal education measured in years of schooling but seem to stem from informal sources.

Introduction

Food safety standards in smallholder agriculture in developing countries

The global agri-food system has changed fundamentally over the last two decades. Food safety and quality concerns are at the heart of the still ongoing process. They increasingly influence purchasing decisions of informed consumers around the world that demand high quality, safe, healthy, sustainable and diverse food (Henson and Humphrey 2009). This change in demand patterns comes together with changing public regulations about food safety and quality (Henson and Humphrey 2010). In addition we see an increasing consolidation of the retail sector and institutional and organizational innovations in global value chains such as a strong trend towards contract farming (Reardon et al. 2009). These developments have far-reaching consequences for how agricultural products are produced, processed and delivered. One main outcome of this transformation process is the increasing use of standard systems as an instrument to assure food safety and quality in global agri-food chains.

The role of standards in agriculture has changed fundamentally over time. There is a trend away from product towards process standards (Reardon et al. 2001). Traditionally, standards were used to regulate the physical characteristics of a product, such as size, color or shape. Nowadays, they are addressing how products are produced – for example through regulations for the use of pesticides, banning of child labor or implementing fair trade relationships. Apart from public standard setters, there is a trend towards private standards where actors such as farmers, retailers, certification bodies or non-governmental organizations set the standard (Reardon et al. 2001). Process standards have become a tool for risk management and product differentiation (Henson and Humphrey 2009). They assure the reduction of food safety related risks in the chain and help to differentiate the products from competitors. For specific market segments, these private standard systems have become a quasi-mandatory prerequisite for participation. This is especially true for fresh fruits and vegetables where food safety and quality plays a crucial role due to their perishable nature (Unnevehr 2000).

Fresh fruits and vegetables have been promoted in many developing countries as part of poverty reduction and rural development strategies (Weinberger and Lumpkin 2007; Carter et al. 1996). Horticulture production is mainly dominated by small-scale production and increases rural employment opportunities and contributes to the commercialization of the agricultural sector (Weinberger and Lumpkin 2007). Horticultural production

and exports have augmented substantially over the last three decades (Norton et al. 2003). Exports of fresh products from developing countries tend to be more often subject to detentions due to pesticide residues or microbiological contamination (Norton et al. 2003). These detentions may have substantial consequences for the small farmers involved in horticulture production. Without sufficient capital and other insurance mechanisms, they are especially vulnerable to external shocks. Producers of horticultural products in developing countries see themselves increasingly being confronted with food safety and quality standards as these determine the participation in international high value chains.

Problem statement

Food safety and quality standards have gained increasing attention in the development oriented agricultural economic literature. Compliance with international norms is in many cases important for market access and participation in high value food chains. Food safety and quality has also gained recognition for its important role in achieving food security (WHO and FAO 2014). The high importance of food safety for agricultural development stays in sharp contrast to the weak quality infrastructure of many developing countries. The public infrastructure is often insufficient in providing food safety and quality as a public good to citizens and economic actors alike. The countries are missing regulation and enforcement mechanisms as well as certification and accreditation bodies or laboratories. Private standard systems seem to step into this regulatory gap (Henson and Humphrey 2010).

A controversial discussion has emerged and centers on whether standards are good or bad for poor farmers in developing countries. The increasing use of private food safety and quality standards raises the fear of smallholder exclusion from profitable markets. Private standards may act as non-tariff barriers to trade (Maertens and Swinnen 2009), since the high recurrent and non-recurrent compliance costs are seen as a high barrier towards standard adoption among small farmers (Hobbs 2010). The weak institutional environment, combined with inadequate capacities and skills might further disadvantage small farmers in a food quality and safety-based competition. In this context, standards may have a negative effect on developing countries, asset-poor farmers and rural poverty in developing countries (Jaffee and Henson 2005). A more optimistic view on food safety and quality standards sees benefits for the competitive situation of the small-

farmer based agricultural sector in developing countries. The global trend may be an incentive to modernize and upgrade the export sector with possible spillovers for the domestic agricultural production (Jaffee and Henson 2005; Henson and Humphrey 2010). Standard adoption may lead to higher incomes for small farmers as they benefit from price premium schemes, lower rejection rates or more efficient production processes.

The reality in the small-farming sector in many developing countries is more complex than the dichotomy between standards-as-catalyst vs. standards-as-barriers suggests. Studies concerned with food safety standards in a developing country context address questions of standard adoption and economic impacts. There is empirical evidence for both scenarios. The adoption of food safety standards as well as their impacts seem to be highly context dependent. Endowment with assets and access to information and resources like credit seem to play crucial roles in the adoption of food safety standards (Reardon et al. 2009; Asfaw et al. 2009; Kersting and Wollni 2012; Subervie and Vagneron 2013; Handschuch et al. 2013; Hansen and Trifković 2014). Once small farmers overcome adoption constraints, there is a trend towards positive effects. The overall positive effect is associated with special, more reliable price arrangements, quality improvements, the use of contracts and general tighter suppler-buyer relationships, and higher efficiency in farm input use (Asfaw et al. 2009; Kersting and Wollni 2012; Subervie and Vagneron 2013; Handschuch et al. 2013; Hansen and Trifković 2014). But the impact is not the same for all farmers. The institutional setting (Holzapfel and Wollni 2014), access to infrastructure (Subervie and Vagneron 2013) or farm characteristics such as farm size (Hansen and Trifković 2014) may influence the economic impact of food safety standards. In summary: Farmers with a better capital endowment, better access conditions and a more favorable institutional environment seem to benefit more from standard adoption than those farmers working under more unfavorable conditions.

Food safety and quality standards will continue to play an important role in international horticultural and agricultural trade and increasingly also for the domestic market in the developing and emerging countries themselves (WHO and FAO 2014). The sustainable management of food safety and quality risks is essential for the competitiveness of the

agricultural and rural sector of developing countries (World Bank 2005). Hence, a more systematic knowledge about standard adoption and its heterogeneous impacts is needed.

Objective of the thesis

Taking this into account, the thesis contributes to the scientific debate on food standards in developing countries in a twofold way:

- By identifying factors that help small farmers to adopt a food safety standard
- By assessing the economic impact of standard adoption at the farm level

Our special contribution to the literature on standard adoption and impacts is the consideration of farmers' skills in the form of their financial literacy. Studies explaining standard adoption identify farm characteristics, capital endowment and access indicators (such as access to information or infrastructure) as important determinants. Financial and business related skills have not yet gained major attention in the standard adoption literature, albeit it could contribute to a better understanding of the adoption behavior of small farmers. Financial skills could, for example, help farmers in standard compliance by better farm management, improved management of the limitedly available funds and through better learning abilities. Studies assessing the economic impact of food standards suggest that the impact depends on the context and, thus, is heterogeneous in nature. Whether the economic impact depends on farmers financial skills has not been studied yet. In order to address the research objectives, the thesis embraces theoretical and conceptual approaches to global value chain analysis, reflects on the role of private standard systems in agricultural value chains and presents empirical evidence for the case of GlobalGAP[1] adoption in the small-scale fresh pea sector in Guatemala. GlobalGAP is one of the most important private standard systems addressing food safety and quality. It is especially important for the fresh horticultural sector. Guatemala horticultural exports are mainly produced by small-scale, asset-poor farmers. Among horticultural exports, fresh peas are the most important product. Albeit importing retailers increasingly demand GlobalGAP compliance, the sector has difficulties to develop according to the demands of international markets. Paper three and four are based on a

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[1] The name of the brand is GLOBALG.A.P.; the term GlobalGAP will be used throughout the thesis for better readibility.

random sample of 280 farmers that where interviewed face-to-face in 2012. The quasi-experimental study design includes certified and non-certified farmers.

The thesis is outlined as follows:

Clusters and global value chains: Conceptual approaches and case-study evidence of the agri-food sector

The *first paper* discusses the theoretical concepts of clusters and global value chains that are used to analyze global-local relationships within the agri-food sector. The cluster-approach allows analyzing the spatial agglomerations of economic activities on a local or regional level. Global value chains analysis looks at globally dispersed economic actors that are vertically connected through their trade relationships. The paper highlights the advantages and disadvantages of both concepts, outlines the benefits of combining them and discusses case study evidence.

Supply Chains of Non-traditional Export Products between Latin America and Europe: The Role of Private Certification Standards

The *second paper* discusses the role of certification based food safety standards for non-traditional agricultural exports in Latin America. The empirical evidence on the role of food standards in Latin America is still not very systematic. In order to better understand the effects of the changing nature and importance of standard on developing countries, the paper gives a general overview about certification systems, standard categories and their role in food supply chains. The paper provides case study evidence on the role of food safety standards in non-traditional agricultural exports from Latin America and gives a systematic overview on the findings on food safety standards and developing countries.

Papers one and two represent a systematic discussion on theoretical approaches, conceptualizations and the current research focus on the nature, role and impacts of food safety and quality standards in the agri-food system. This lays the foundation for the following chapters that build the core of the thesis.

Food safety standards in the Guatemalan fresh pea sector: the role of financial literacy in technology adoption

The *third paper* is an econometric study on the determinants of GlobalGAP adoption in the case of small pea farmers in the Guatemalan highlands. A special focus lies in the use of farmers' financial literacy as one important determinant of standard adoption. The results show a positive influence of financial literacy on standard adoption.

Financial literacy and food safety standards in Guatemala: The heterogeneous impact of GlobalGAP on farm income

The *fourth paper* analyzes the economic impact of GlobalGAP adoption on small pea producers in Guatemala. The impact study uses Propensity Score Matching. The study identifies a heterogeneous economic impact according to the financial literacy level of the farmers surveyed. Farmers with a higher level of financial literacy seem to benefit more from standard adoption than those farmers with a lower level of financial literacy.

The thesis finishes with concluding remarks on the general findings, the contribution and the limitations of the studies. Implications for the private and public sector as well as for development policy are discussed and recommendations for further research are presented.

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Clusters and Global Value Chains: conceptual approaches and case-study evidence of the agri-food sector

1. Introduction

Global agri-food systems are currently undergoing a rapid transformation towards growing demand for high-value agricultural products in developing and developed countries, trade liberalization of agricultural products, more stringent food safety and quality requirements, and intensified vertical coordination exercised by global lead firms (Reardon et al. 2009). There is a considerable debate on whether these developments include or exclude developing country firms' from participating in emerging export supply chains that offer new and attractive marketing opportunities (Henson and Reardon 2005, Henson et al. 2005, Hernandez et al. 2007, JaVee and Masakure 2005, Maertens and Swinnen 2009, Maertens 2009).

An emerging business concept that can help developing country firms to enhance their competitiveness, to access export markets and thus link to remunerative global agricultural value chains is clusters (FAO 2010). Initially applied to developed countries, the cluster concept was over time introduced into a developing country context (FAO 2010, Humphrey and Schmitz 1999). Generally, cluster research is used to analyze the *local* sources of competitiveness that emanate from spatial proximity of inter-related firms by identifying joint action and local external economies benefits (Nadvi 1999). Dynamic clusters often participate in export markets and are thus integrated into value chains driven by global lead firms. The global value chain (GVC) concept enables to analyze the degree of vertical coordination pursued by global buyers and thus the type of chain governance the cluster is exposed to. This has significant implications for local development and local firms, where clusters are inserted global value chains (Humphrey and Schmitz 2000).

Hence, the objective of this paper is first to conceptually describe the concepts cluster and global value by shedding a light on their commonalities and differences. Second, we call for the necessity to link the concepts, where clusters are integrated into GVC and provide theoretical and empirical evidence. The remainder of the paper is organized as follows: section 2 will introduce and critically review the main concepts of this paper, cluster and global value chains. The subsequent section is concerned with possibilities on how to link the two concepts. The fourth section provides some empirical evidence on clusters and global value chains in the agri-food sector of developing countries

by presenting case-studies from Chile and Guatemala. The paper closes with concluding remarks and directions for further research in section 5.

2. A review of cluster and global value chain research

2.1 Clusters – local panacea or fuzzy concept?

Since the beginning of the 1990s cluster is a well-known term among scholars and policy-makers. At this point, Michael Porter (1990) as the most influential representative examined determining factors for location competitiveness in his milestone 'The competitive advantage of Nations'. He found that the world map is dominated by specific regions with unprecedented economic success in specific industrial subsectors like the shoe industry in Italy, the high-tech-industry in the Silicon Valley or the automobile industry in Southern Germany. Porter termed these peculiar spatial agglomerations clusters and defines them as a "geographic concentration of interconnected companies and institutions in a particular field" (Porter 1990). Interconnected companies are complementarily engaged in providing a related product or group of products or services and create value networks. Companies can range from producers, specialized suppliers to processors and service providers. Therefore, clusters can be seen as a special form of the spatial organization of a value chain in which interconnected firms are spatially concentrated (Porter 1998). In his theoretical framework, Porter argues that clustered firms reach a higher level of firm performance and competitiveness as compared to firms that are not clustered (Porter 2000). The driving force for this is mainly seen in the firms' higher productivity (Ketels and Memedovic 2008). Determining factors that enable higher productivity stem from advantages inherent in clusters summarized in figure 1.

Market access	
Specialized labor pool	
Higher innovation capability	**Higher productivity and competitiveness**
Knowledge/information spillovers	
Lowered transaction costs	
Trust building	
Joint purchasing/marketing	
Better coordination	
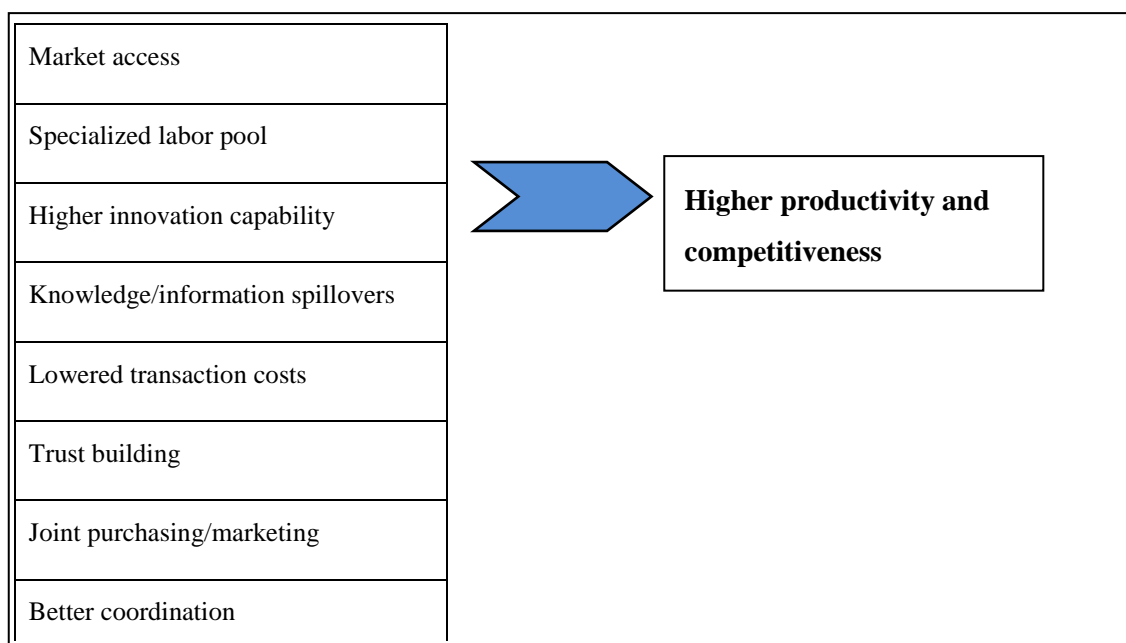
Figure 1: Theorized cluster advantages as drivers for higher productivity

Sources: Ketels and Memedovic 2008, McCormick 1999, Porter 2000, Schmitz and Nadvi 1999

The cluster concept is, however, not an entirely new phenomenon. Its roots date back to Alfred Marshall (1890), who found that spatially concentrated firms in the textile and metalworking regions of England, Germany and France enjoy local external economies like knowledge and technology spillovers or a pool of specialized workforce. Moreover, Adam Smith (1904) looked into the specialization of firms on a single stage of the production process, which also predominates in clusters. His study reveals that firms specialized on only one stage of the production process obtain economic gains. Another important theoretical argument in favor of clusters is its link to the endogenous growth model developed by Romer (1986). Romer integrated innovation capability and knowledge spillover in the model as the key determinants for economic growth. Consequently, it is possible to consider clusters which enhance innovation capability and knowledge spillover as engines for regional growth.

Over the last three decades the ideas of Marshall and other influential scientist were rediscovered by numerous scholars, who build up a substantial body of cluster literature (Kukalis 2010). This enthusiasm aroused in a wide array of scientific disciplines such as economic geography, business economics or development studies (Humphrey and Schmitz 2000). Initially, cluster research was mainly focused on the industrial sectors of

developed countries (FAO 2010, Schmitz and Nadvi 1999). At a later point, however, the cluster model became increasingly popular among development researchers and practitioners. Hence, a special issue of World Development (Humphrey 1995) was devoted to applying the successful European industrial district model to *developing countries*. As compared to clusters, the industrial district concept stronger highlights the importance of horizontal inter-firm networks and institutions (Bair and Gereffi 2001). A research agenda entirely devoted to industrial clusters in developing countries lead to another special issue in World Development in 1999 (Schmitz and Nadvi 1999a).

So far, this not paper did not address the question why clusters matter in the context of developing countries and poverty reduction. Although being a relatively underdeveloped topic, the literature points to a number of reasons for this. Primarily, the positive relationship between clusters and poverty reduction can be understood from direct impacts through a private sector development (PSD) perspective. Cluster theory assumes that clustered firms are more competitive and can achieve a higher level of firm performance than isolated firms. This in turn fosters growth prospects for those firms. There is an implicit assumption that such growth translates into rising levels of employment and incomes for the poor. In addition, vibrant clusters can ease the access to global markets and can thus offer prospects for higher export earnings and the acquisition of technology and knowledge through global lead firms. Clusters can also have indirect impacts on growth in the local economy through raising demand for local products through higher incomes (UNIDO 2004). Using a broader perspective of poverty, the degree of poverty reduction through cluster development also depends on whether the poorest, most vulnerable groups can benefit. In addition, factors like labor intensity of production and remoteness (rural or urban cluster) have to be beard in mind when analyzing poverty impacts. The greatest limitation for measuring poverty implications is the lack of evidence on counterfactuals (UNIDO 2004).

Despite of the enthusiasm about cluster development in developing countries, surprisingly little attention has been paid to *agricultural clusters* (AC). This is particularly noteworthy against the background of widespread poverty among agricultural and rural households. It is assumed that agricultural clusters can help to raise competitiveness and to advance the agricultural sector with direct and indirect implications for poverty re-

duction (FAO 2010, UNIDO 2004). Drawing on Porter's initial definition, AC[2] can be defined as "concentration of producers, agribusiness and institutions that are engaged in the same agricultural or agro-industrial subsector, and interconnect and build value networks when addressing common challenges and pursuing common opportunities." (FAO 2010). Similar to industrial clusters, AC enable small-scale farmers and agribusiness to engage in higher productivity and more remunerative market-oriented production. Moreover, competitive clusters offer great potential to access agri-food export markets and to link to global agricultural value chains. Thus, due to better firm performance of clustered as compared to isolated firms, these are very attractive suppliers for national or global buyers (FAO 2010).

When applying the cluster concept on the agricultural sector in developing countries, there are a number of aspects that have to be taken into account.

Due to higher knowledge- and technology intensity of production in *developed countries,* cluster advantages like technology spillover or enhanced innovation capability (see also figure 1 on page 3) might not be easily transferable. Agricultural and agribusiness production processes are usually less sophisticated and technology-intensive, but more labor-intensive. Therefore, for developing country agricultural clusters, the reduction of transaction costs, trust building through repeated transactions, better coordination of market transactions, rapid exchange of information, better access to inputs and services, and joint actions (joint purchasing or marketing for example) are more likely to yield the primary benefits of clustered firms in the agricultural and wider agribusiness sector (FAO 2010).

In particular, the reduction of transaction costs can be a major factor in clusters. The spatial proximity of firms and their repeated market transactions foster trust and better coordination which is a major advantage as compared to isolated firms. Accordingly, the institutional arrangements of market transactions between clustered firms are in between the extremes of open spot-markets and hierarchies (Porter 1998). Thus, the prospects for engaging in institutional arrangements as verbal agreements or contracts with

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[2] The technical term "agricultural clusters" and FAO terminology "agro-based cluster" are used interchangeably

which firms will potentially capture a higher price and a reliable income are much higher (FAO 2010).

The development of the cluster concept by Michael Porter in the early 1990s brought along great enthusiasm by researchers and policy-makers alike (Thomi and Sternberg 2009). Despite of this growing interest, a great deal of criticism was expressed on the ambiguity and vagueness of the cluster definition and the claims of its theoretical framework (Martin and Sunley 2003). Likewise, there is neither a clear and consistent approach for empirically proving the existence of clusters nor for the determination of the geographical scale (Thomi and Sternberg 2009). The result is conceptual and empirical confusion. As Martin and Sunley (2003) put it: "The situation in the cluster literature seems to be reverse: we know what they're called, but defining precisely what they are is much more difficult." The biggest concern, however, relates to proving the existence of clusters. In many studies, researchers criticize that often times there is no effort being made to identify clusters. Instead, the existence of clusters is simply assumed or asserted. In these cases researchers would often rely on lists of clusters set up by local cluster development initiatives, without empirical inspection using a set of adequate criteria. This gave authors and policy-makers unlimited scope for the definition and application of the cluster concept (Martin and Sunley 2003).

Nevertheless, for the empirical identification of clusters, a few studies suggest two methods: a top-down and a bottom-up approach. The top-down approach utilizes secondary data in order to investigate whether economic (sub-) sectors (agriculture for example) are concentrated in certain areas (a district for example). As statistical measure for this operation the coefficient of localization is mostly be applied. Bottom-up approaches rely on qualitative approaches as interviews with key-informants in order to carry out social network analysis. This can help to understand the density of the cluster and the intensity of inter-firm relationships (Thomi and Sternberg 2009). The application of the top-down approach requires the availability of aggregated employment and production data on the local, respectively regional level. For *developed countries* these data is often compiled in statistical yearbooks. Obtaining this data in *developing countries* is, however, quite a challenge. Therefore, the top-down approach in developing countries is in most cases unfeasible. Even if adequate data was available on the local level, with the help of statistical measures we would solely find concentrations of a spe-

cific economic subsector, i.e. the agricultural sector. This is, however, not surprising since agriculture is by far the most important economic sector in terms of employment and land use. It is therefore more adequate to identify agricultural clusters for a specific product as has been done in several studies on the avocado cluster in Kenya (Knopp and Smarzik 2008) or the Lake Victoria fishing cluster in Uganda (World Bank 2008) for example. Finding adequate data on the local level on employment or production for a specific agricultural product is surely almost impossible.

To sum up, the current state of research on agricultural clusters in developing countries exhibits only few empirical studies. Most cluster studies were targeted at the manufacturing sector. In addition, a lack of counterfactual evidence is obvious. Cluster research is mainly focused on descriptive and qualitative analysis which points to the lack of rigorous econometric techniques inferring causal relationships. The biggest weakness, however, is the absence of clear and consistent approaches on the empirical identification of clusters. Most studies simply claim their existence, which leads to arbitrary applications of the cluster concept, often referred to dream clusters in the literature. Further research is thus needed to find consistent indicators with which the existence of clusters can be proved, in particular against the background of limited data availability in developing countries.

2.2 Global Value Chains – a conceptual approximation

Global Value Chains (GVC) has become a dominant topic in social and economic sciences among a variety of disciplines including business studies, economic geography, development studies and agricultural economics. In the context of a wide range of applications of GVC research the overall objective of this chapter is to clarify the central concepts of GVC. Therefore, we will trace the development of GVC research and describe the underlying theories and disciplinary influences. We will focus on a developing country context where GVC are applied to study the agricultural sector. Due to intensified globalization processes, we simultaneously observe an increasing vertical disintegration of transnational companies that comes along with more stringent vertical coordination. In this context, GVC research seeks to explain patterns of industrial and economic organization.

A GVC describes „the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final disposal after use." (Kaplinsky and Morris 2001). The focus is on all value-adding activities in and between firms. Value chains produce value-added products or services, by transforming resources and by making use of the surrounding infrastructure – within the opportunities and constraints of the institutional environment (Trienekens 2011). They can be conceptualized as a means by which new forms of production, technologies, logistics, labor processes and organizational relations and networks are introduced.

Humphrey (2005) sees four advantages of the chain metaphor:

1) It highlights the fact that goods and services are produced and brought to markets in a sequence of processes by different companies.

2) It draws attention to the way these processes are linked, i.e. the organization of economic processes

3) It points to the obvious flow of goods and services, which is accompanied by the exchange of information about prices, production and process requirements, power, knowledge etc.

4) It makes clear that the efficiency of the whole system depends on the efficiency of every single actor and the linkages between them (systemic competitiveness). This perspective allows considering the embeddedness of economic actors in an institutional system (local, regional, global) and the construction and management of network relationships. GVC describe the whole production system and does not look at isolated sectors or industries (contextualization of economic activities).

One main focus of GVC research is to clarify how globally fragmented economic activities are coordinated and regulated. Traditionally, the relationships and transactions in GVC were organized and coordinated through either purely market-based mechanisms or vertical integration. Increasingly, explicit coordination through network governance can be observed. Governance in the context of GVC describes the exercise of control of powerful lead firms over the other actors in the chain. Without direct ownership these firms set parameters for products, processes and logistics (Humphrey and Schmitz

2004). Firms and producers have to adjust to the "rules of the game" set by powerful chain actors.

Those parameters have to be enforced – hence governance in GVC includes monitoring and enforcement mechanisms (Humphrey 2005)**.** Governance takes place in the form of standard systems (public and private), contractual arrangements or other forms of explicit coordination. Firms incur the costs of explicit coordination due to product differentiation and risk management strategies (Humphrey 2006). This is in line with the tendency in the global agri-food system to source differentiated products with food quality and safety as one of the most important factors of competitiveness.

Several approaches theoretically attempt to capture theoretically the governance of activities in globally dispersed economic activities. In the 1980s, Hopkins and Wallerstein introduced the concept of Global Commodity Chains (GCC) that is strongly influenced by world systems theory (Sturgeon 2008). The concept emphasizes the role of the state in shaping global production systems with instruments like tariffs and defines a GCC as a "network of labor and production processes whose end result is a finished commodity" (Gereffi and Korzeniewicz 1994)**.** A GCC interlinks households, firms and states in the global economy and the approach has a strong process-orientation. The analysis of a chain allows referring on the power of social relations and organizations in shaping production, distribution and consumption.

Another stream of literature dealing with chain and network concepts is related to business studies and supply chain management. Michael Porter introduced the concept of the value chain in the 1980s (Porter 1986). This approach focuses on the value-adding activities within a firm or a network of firms and entails a strong strategic management component. Power, institutions and spatial embeddedness is not considered in this concept. Instead the literature is more concerned with management processes, logistics, supply chain efficiency and is strongly customer oriented. (Stamm 2004), (Trienekens 2011).

In 1994 Gereffi and Korzeniewicz refined the GCC concept by distinguishing between *producer-* and *buyer-driven chains*. In *producer-drive chains*, producers have the power to control and impose parameters on the other actors in the chain. In *buyer-driven chains* the buyers influence the shape of the production system while at the same time

not directly being engaged in manufacturing activities. By introducing this distinction, they focused on the firm-level recognizing the limited ability of the nation state to regulate international trade in the time of increasing globalization. Power and power asymmetries between economic actors play a central role in the cross-border organization of economic activities. GCC analysis allowed to link processes on the macro and micro level and introduces a specific spatial component into the analysis of economic inequalities. Special emphasis is given to the governance of cross-border economic activities.

The concept of GCC is very static in nature and does not capture the variety of network forms that are governing globalized production chains. The *buyer vs. producer-driven* dichotomy was overcome by the work of (Gereffi et al. 2005): they developed a dynamic and operational theory of governance in GVC by identifying five governance types that range from market to hierarchy. The complexity of transactions, the ability to codify transactions and the competencies in the supply base determine the dominant governance form between the chain actors. The degree of explicit coordination and power asymmetries increases from market to hierarchy.

The governance form of a GVC chain is dynamic and different forms of coordination may coexist in the same chain. Changes in producers' capabilities may reduce the necessity for direct intervention by the buying firm. At the same time, this may further induce more value capture by the producer. Better farm-level capabilities may lead to more balanced power relationships and less information asymmetries in the chain (Trienekens 2011).

The approach of governance in GVC is essential for understanding how firms in developing countries can gain access to global markets, and what the benefits and risks for access might be (Gereffi et al. 2005). Yet, several weaknesses of the described approach can be claimed. The empirical application of the model is difficult as it is questionable how the key variables can be measured. The concept does not consider the embeddedness of value chain actors in a specific institutional setting on the local or national level. Value chains do exist in space. The horizontal relationships with other actors and the specific institutional environment influence the coordination and development of the chain and its actors.

Nadvi highlights that the GVC methodology allows to scrutinize the effects of world market participation on firms, farms and other actors (e.g. households), particularly the vulnerable small and informal economic actors. Mapping GVC can give insights on risks, vulnerabilities and possible gains. In the context of pro-poor growth strategies these insights may be useful for the policy debate. Smallholders have difficulties to be integrated in and benefit from GVC.

(Trienekens 2011) identifies three patterns that hinder GVC development in developing countries.

1) *Market access and market orientation:* usually in developing countries different food-subsystems with different quality demands do co-exist. The coexistence of these weakly connected subsystems poses challenges on the development of and compliance with food quality and safety standards. GVC access is influenced by market orientation (to serve the end users demand) and market knowledge. Therefore, producers' access is constrained by the lack of market information and the lack of ability to translate this into market intelligence.

2) *Resources and physical infrastructure:* physical resources, geographical position, education level of the labor force, distribution and communication infrastructure constrain GVC development.

3) *Institutional voids:* regulative, normative and cognitive institutions influence GVC development. Many developing countries face a weak institutional environment that is not market supportive, e.g. the lack of an adequate food quality and safety infrastructure.

In the context of an increasing complex agri-food system, these three areas of constraints to value chain development in developing countries call for further research. Deeper insights are needed to develop policies and programs that help private sector development and smallholders' integration into the chains.

3. Linking cluster and global value chain research

Over the past two decades or so, clusters and global value chains have become common concepts in development studies and related disciplines (Bair and Gereffi 2001, Giuliani et al. 2005, Humphrey and Schmitz 2000, Humphrey and Schmitz 2002). Although both

are concerned with inter-firm relationships and ways to enhance competitiveness of firms, several distinctions stand out that touch upon their strengths and weaknesses.

Probably the most striking difference between clusters and global value chains is the geographical scope. On the one hand, clusters are concerned with interactions on the *local* level. Global value chains on the other hand focus on the *global* level. This first distinction becomes unequivocal when considering the different stages of value adding of a specific product. In a global value chain the focus is on *all* value adding activities from raw material production to distribution and marketing that are carried out by a complex network of globally dispersed firms. This implies that global value chains are not limited to a certain location, but in fact cover global cross-border linkages between inter-related firms (Humphrey and Schmitz 2000, Schmitz and Knorringa 2000).

As opposed to the GVC concept, the focus in clusters is not on *all* value adding stages of production, but only the ones that take place within the boundaries of the cluster. Thus, clusters do not necessarily incorporate all value adding activities from raw material production to marketing. For instance, clustered firms may produce an intermediate agri-food product which is exported and processed in a different country. Clusters can then be considered as a specific node of a global value chain (see figure 2 for a theoretical example). In addition, clusters focus not only on vertical inter-firm relationships, but also on horizontal linkages between intra-cluster firms and with supporting institutions. In a nutshell, in cluster research we are exclusively interested in inter-firm activities confined to the local level (Bair and Gereffi 2001, Giuliani et al. 2005, Humphrey and Schmitz 2002).
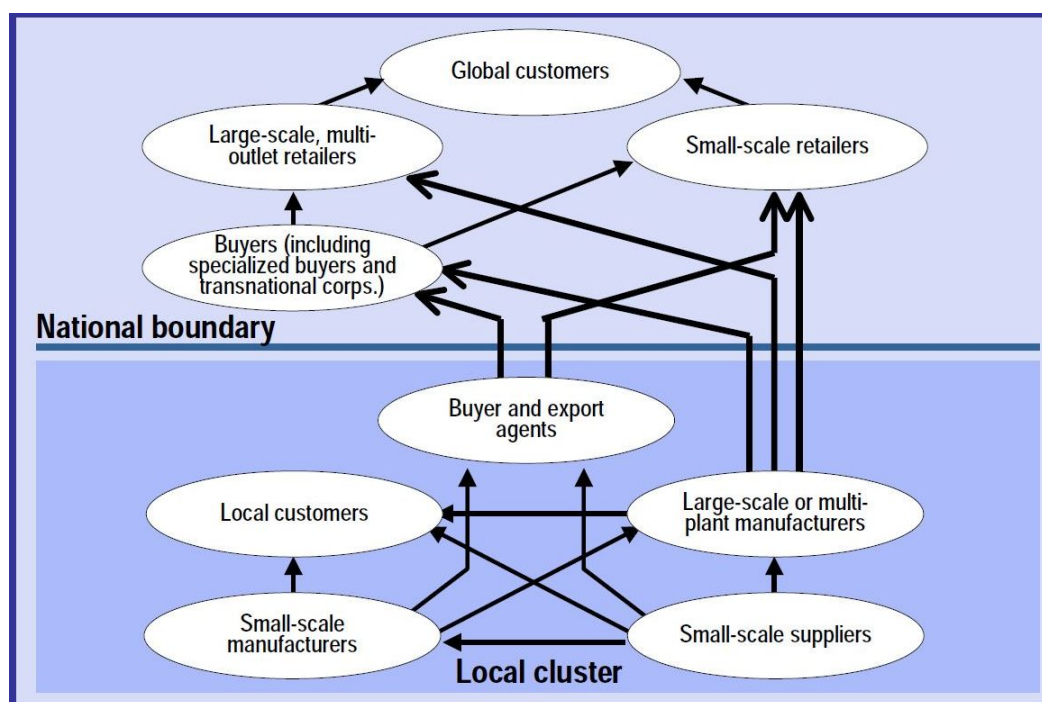
Figure 2: Local cluster inserted into global value chain
Source: UNIDO 2003

Consequently, the major strength of the cluster concept is to analyze the local sources of firm competitiveness. The collective efficiency framework helps to identify the main determinants for competitiveness. This framework is divided into advantages emanating from joint actions (deliberately pursued activities between firms) and local external economies (unintended, passive benefits). As a result, cluster research can help to identify constraints for local competitiveness, to derive policy measures to improve the local business environment or to strengthen firm-level cooperation (Nadvi 1999, Schmitz 1995, Schmitz and Nadvi 1999b).

As thoroughly as the collective efficiency framework stresses the importance of local drivers for competitiveness, it fails to capture external linkages with the outside world. This is particularly noteworthy for vibrant clusters that are export-oriented and thus have access to the world market. Yet, the cluster concept acknowledges relationships with the external world, but they are assumed to be based on arm's length relationships. Transactions with the outside world, however, are not market by arm's length relationships: clusters are rather integrated into global value chains controlled and coordinated by global buyers that set parameters for what, when, how and at which prices has to be produced. Hence, the specific governance form of these chains can have far-reaching

consequences for local firm strategies, firm performance and opportunities for upgrading which is not sufficiently captured by the cluster concept (Giuliani et al. 2005, Humphrey and Schmitz 2002). Hence, the limitation of focusing on local interactions is considered to be the main weakness of the cluster concept by many authors (Bair and Gereffi 2001, Giuliani et al. 2005, Humphrey 1995, Humphrey and Schmitz 2000, Schmitz and Nadvi 1999b).

Conversely, the global value chain concept draws attention to a whole chain perspective incorporating all vertical value-adding processes from raw material production to marketing, irrespective of the geographic location of the value chain actors. Thus, clusters can be considered as nodes of a GVC or a global network of inter-related firms. The global value chain concept can be used as an analytical tool to map the interrelations between clusters and globally dispersed firms in a specific value chain (Giuliani et al. 2005, Humphrey and Schmitz 2000, Humphrey and Schmitz 2002, Nadvi and Halder 2005). Obviously, while focusing on the vertical inter-firm relationships in a specific global value chain, the biggest weakness of this concept is the neglect of the local space in terms of interactions between firms and between firms and the surrounding institutional environment (Humphrey and Schmitz 2000, Humphrey and Schmitz 2002). Instead, the GVC concept focuses on the vertical relationships between suppliers and buyers and the corresponding channels for knowledge, technology and skills transfer as the main benefits (Schmitz and Knorringa 2000). Additionally, global buyers can help local clusters to access distant markets (Murphy 2007).

The neglect of local inter-firm cooperation and local external economies as sources of competitiveness has some important implications. It is argued enhancing these local forces can improve firm capabilities and thus lead to a more equally based type of chain governance which allows better opportunities for upgrading and thus more favorable development outcomes.

We argue that studies of such clusters should be supplemented by the global value chain perspective which takes account of the role of and relationships with global buyers. In doing so, we can examine the effect of global chain governance on local level trajectories of firm performance, business strategies and upgrading. In addition, by providing counterfactual evidence we can investigate the effect of clusters inserted into global value chains on specific firm-level determinants as learning, innovation capability or

capacity development (Bair and Gereffi 2001, Giuliani et al. 2005, Humphrey and Schmitz 2000). Despite of this necessity, however, there is limited empirical evidence on linking cluster and global value chain research. The available literature integrating the two concepts in a developing country context is exclusively tailored to the industrial sector as the following explanations will show.

Bair and Gereffi (2001) examine the Torreon blue jeans cluster in Mexico and the local developmental implications using a global value chain approach. More specifically, they investigate the effects of the arrival of new buyers from the US market with different sourcing demands on the organizational structure of the cluster and local development. They find that this new sourcing systems focusing on full-package production restructured the intra-cluster production and inter-firm networks. The study further reveals that the establishment of full-package production significantly enhances upgrading opportunities at firm- and industry-level. In addition, they observe major positive outcomes for the local labor market.

Humphrey and Schmitz (2002) scrutinize local upgrading opportunities for developing country clusters that are integrated into global value chains. Similar to Bair and Gereffi (2001), they argue that the type of chain governance and thus the role of the global lead firms have extensive implications for upgrading efforts in local clusters. Using GVC and upgrading as analytical tools the authors show that quasi-hierarchical chains are advantageous for rapid product and process upgrading, but hinder functional upgrading. Chain governance marked by even networks offer the most favorable opportunities for upgrading, but are rarely found among developing country firms due to lower firm capabilities.

Giuliani et al. (2005) apply a comparable approach in their study on clusters and global value chains in Latin America. The authors investigate the impact of global value chain governance on upgrading opportunities in local clusters by distinguishing between different sectoral patterns of innovation. For the sectoral patterns of innovation Giuliani et al. (2005) use the Pavitt taxonomy which classifies different sectoral groups according to their pattern of technological, innovative and learning behavior. They find the type of global value chain governance strongly affects local firm-level upgrading. In addition, the authors demonstrate that also the degree of collective efficiency in the cluster has significant implications for upgrading prospects at the local level.

5. Case-studies

5.1 The Chilean wine cluster – external linkages and knowledge absorption

The Chilean wine industry has a longstanding tradition. It was introduced by the Spanish-Mexican Jesuits in the nineteenth century, who sought to capitalize on Chile's excellent natural endowment for wine production. Until the 1960s Chile's wine production tailoring the low-end domestic market grew significantly, but only a fraction was exported. This changed dramatically over the upcoming thirty years, in which Chile rose as a new global player for premium wines (Giuliani and Bell 2005). Until the end of the 1990s, the share of exported wine increased to almost half of the total production. Simultaneously, the value of the countries' wine exports increased sharply indicating a ramp-up in quality. Since the 1990s, also domestic consumer preferences shifted from low to high-quality wine (Giuliani 2011). Chile's success story in export-oriented high-value wine production continued in the new millennium, when rapid economic success took place within this sector (Giuliani and Bell 2005).

Currently, wine is produced in fourteen different regions of the country. This case-study focuses on the Valle de Colchagua cluster. It is located about 180 kilometers southwest of Santiago de Chile. The cluster consists of mainly micro and small-scale grape growers and wine producers, whereas further downstream and upstream value chain actors are located outside of the clusters' boundaries or abroad. In addition, the cluster accommodates supporting institutions like a business association, a training institute and a technology transfer office connected to the University of Talca (Giuliani 2011).

This unprecedented economic success of the wine industry in Chile, termed the 'wine revolution' also reached the Valle de Colchagua cluster. Cluster firms invested heavily over the past decades and could thus catch up with global competitors (Giuliani 2007). The main reason for the dynamic development of the cluster is continuous firm-level product and process innovation like new wine blends, more advanced pruning, irrigation and canopy management or new marketing strategies (Giuliani 2011). For those intra-cluster innovations to take place, acquisition of new knowledge and learning is essential. There are three channels through which new knowledge was absorbed and diffused in the cluster. First, many firms had linkages with domestic research and technology

institutions and with universities. Second, the country spawned a large number of high-ly-qualified oenologists and agronomists which gave advice to cluster firms. Third and most importantly, the external openness of the cluster and thus the linkages with external actors and the benefits through their specialized knowledge and technological capabilities has been critical (Giuliani and Bell 2011).

In order to benefit from external sources of knowledge and technology, clusters need to have a high cluster absorptive capacity. This is defined as the capacity of clusters to absorb, diffuse and exploit extra-cluster knowledge. Giuliani and Bell (2005) found out that due to the different firm-level absorptive capacities, linkages established with external actors are unevenly distributed. In particular, what they call technological gate-keepers (TG) are crucial in order to absorb this new knowledge, ideas and technologies. TG are externally oriented and technologically advanced firms which with their role as primary connectors enable to broaden the intra-cluster knowledge network. In addition, the function of TG is to avoid technological lock-ins to an increasingly obsolete technological trajectory by interacting with external actors (Giuliani 2011).

The specific characteristic of clusters – the spatial concentration of inter-related firms – is essential for the dissemination of absorbed knowledge from outside by the TG. The major channel for transfer of knowledge and technology within the cluster are social networks of workers based on spontaneous, informal talks. These workers usually share common values and trust in stable and reciprocal relationships that are established through the economic activities and functioning of the wine cluster (Giuliani 2007).

This paper shows the emergence of an organizational model where extra-cluster knowledge is bridged into the cluster through foreign as well as domestic firms. It is absorbed primarily by technologically advanced firms that are crucial for disseminating knowledge to other firms such that the whole cluster can upgrade in product and processes. These product and process innovations are considered as central for economic success story of the wine cluster. The clustering of firms enabled to form social connections which were the major driver for knowledge transfer from TG to smaller, less advanced firms. The Colchagua wine cluster is a good example on how clusters can help to absorb and disseminate new knowledge, upgrade and thus increase competitiveness in the context of globalization.

5.2 The snow peas export chain in Guatemala

In the late 1970s international and national development bodies started to promote the production and export of non-traditional agricultural products in developing countries. It was seen as a means to get the countries out of the commodity dependency and to reach poverty reduction and local economic development on the micro level. Integration into high-value horticulture chains is still considered a promising but also challenging development strategy: the labor-intensive production patterns and the high demand for low-skilled workers may enhance smallholder's participation in GVC and lead to positive income gains. Horticulture was one of the fastest growing sectors in international agricultural trade in the past decade. Trade is highly globally integrated and big (western) retailers control the production and distribution system. The trend goes towards a tighter organization of the chain and a preferred supplier system. Buyers tend to hand over new tasks to the producer. Thus, production and trade is subject to a complex public and private regulatory framework: food quality and safety, but also environmental and social patterns increasingly lead to global competition. Compliance is the basic requirement for trade integration. The organizational and institutional changes in the horticulture GVC impact directly on developing countries farmers (Nadvi 2009).

Since the introduction of non-traditional agricultural exports (NTAE) in Guatemala in the 1970s the sector remains dominated by smallholder farmers. Until today, the development of this sector is mainly donor driven (Díaz and Hartwich 2009). Snow peas have been the main focus of this trend and are the main fresh vegetable export crop. Around 30.000 producers are involved in the snow pea export sector. Geographically, the production is concentrated in the highlands. 90 % of the production is grown on plots with less than 1 ha with an average of 0.3 hectares per farmer (Carletto et al. 2007, Hamilton and Fischer 2003).

Since the 1990s the sector has lost a lot of its competitiveness. Violations of sanitary and phytosanitary measures lead to high rejection rates in the importing countries (Henson and Blendon 2007). The main problem is the overuse of pesticides and microbiological contamination. Statistics from 1998 to 2003 indicate a detention rate of up to 80% at the US border for Guatemalan snow peas (Henson and Blendon 2007). Apart from these problems, Guatemala is still the world leading snow peas exporter in quantity and total value. Main markets are the US, 65, 8% of snow peas imports came from Guate-

mala in 2006 (Henson and Blendon 2007). The EU 27 is the most important extra-regional trading partner.

In the marketing of snow peas, individual producers or producer organizations work either directly with the exporter or with a middleman. In the context of increasing standard stringency (e.g. GlobalGAP is a quasi-mandatory standard for exports to Europe) exporters tend to have more direct relationships with the producers to guarantee product and process quality and traceability (Elbrächter 2011). In order to foster standard compliance among smallholders, exporters assume new tasks like capacity building and the supply of monetary and technical inputs. As asset specific investments increase, exporters are interested in formalizing and strengthening the relationships to the producers by the use of contracts, offering fixed prices and increasing the switching costs (Elbrächter 2011). Notwithstanding, contract breach is still an unsolved problem in the producer-exporter relationship. Trust seems to play a very dominant role in the coordination of the relationships.

Snow peas are a very good example for the introduction of a product, the development of a new sector and the insertion of small farmers into a highly competitive and regulated GVC. In the context of a still very high poverty rate among smallholder horticulture producers in Guatemala, a closer look at the development impact of the GVC integration seems convenient. From a development perspective, the value-added generated on the local level matters.

6. Conclusion

The concepts of cluster and GVC are two widely applied approaches when it comes to analyzing firm-level and sector competitiveness, development perspectives and global-local relationships in the agri-food sector in developing countries.

While clusters highlight the spatial agglomeration of economic activities on a local or regional level, GVC look at the vertical connection of globally dispersed firms. As outlined in our paper, the cluster concept does not sufficiently consider the possible insertion of the clustered firms in GVC and hence neglects important influences that result from vertical relationships. The GVC concept on the other hand, overemphasizes the vertical relationships between globally fragmented actors that disregard the embed-

dedness of GVC-actors in a local institutional setting. These reflections have important implications. Both concepts are popular in local economic development strategies. But is insertion in GVC sufficient if the local context is not considered? Is the development of clusters the solution if there are unobserved vertical global-local influences?

Our case studies from Chile and Guatemala show that the application of the concepts leads to fruitful insights, but cannot capture the whole picture. We propose a careful combination of the two concepts to outweigh the respective shortcomings. Hence, there is need for more conceptual work as well as empirical evidence using the combined approach in the context of agri-food industries in developing countries.

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Supply Chains of Non-traditional Export Products between Latin America and Europe: The Role of Private Certification Standards

1. Introduction

Quality control and quality management have a long tradition in food supply chains. Due to high information asymmetries between producers, processors and consumers and the high relevance of credence attributes in the food sector, attempts to protect consumers against food hazards, product adulteration and deception have a long history. Since trade in agricultural and food products was one of their main income sources and crucial for the supply of the local population, antique and medieval towns laid down regulations on food quality, food inspections, and metrics and weights (Mettke 1979). In many industrialized countries, the late 19th century marked a starting point for a more systematic and comprehensive regulation of food quality based on more advanced natural science knowledge and improved analytical methods. The following decades saw a systematic expansion of food quality regulations and inspections on a national basis and, later on, a growing trend towards international harmonization of food laws (Scheuplein 1999; Kastner and Pawsey 2002). In Europe, General Food Law Regulation (EC) 178/2002 has strongly contributed to the ongoing international harmonization trend by providing, for instance, consistent definitions of technical terms such as food, feed or placing on the market. Furthermore, the General Food Law Regulation has introduced several new principles that can, at least to a certain degree, be considered typical of 21st century legislation on food quality: from farm to fork, precautionary principle, traceability, risk assessment, risk management and risk communication, etc. (Streinz, 2007).

Over the last one and a half decades, legislation on food quality and safety has been supplemented more and more by public and, in most cases, private certification standards based on third-party control (Newslow 2001; Böcker et al. 2003; Hatanaka et al. 2005). This development has triggered vivid discussions about the determinants and effects of the implementation of (private) certification standards in food supply chains (for instance, Theuvsen et al. 2007; Schulze et al. 2008). Furthermore, the international dissemination of certification schemes has received widespread attention (Gawron and Theuvsen 2009). In the last ten years, the emergence and increasing stringency of private food safety standard systems fueled the discussion about their role in and impact on developing and emerging countries and producers, especially smallholders. The debate is centered on the dichotomy standards as catalysts for development vs. standards as

barriers to trade (Anders and Caswell 2009; Mergenthaler et al. 2009). Integration into the global agri-food system is increasingly determined by compliance with specific private and public food safety standards. As most developing and emerging countries are characterized by a strong agricultural sector, integration of producers into global value chains is seen as a strategy to increase incomes and foster modernization (Theuvsen and Voss 2012). This explains the concern that researchers and practitioners manifest regarding the trade and development effects of standards. Do certification standards serve as non-tariff trade barriers that protect the agricultural markets of more developed countries from low-cost imports? Or do they function as door openers that help producers and processors from developing and emerging economies to enter the food markets of the Global North?

Since the mid-1980s, many Latin American countries have pursued strategies of strongly increasing agricultural exports (Challies and Murray 2011). Whereas some countries have focused mainly on traditional agricultural products, such as soy beans, sugar cane or beef and poultry, other countries have put a greater emphasis on non-traditional agricultural products, such as vegetables, berries, or salmon. Chile is a typical example of the latter. In the past three decades, Chile's non-traditional agricultural exports have significantly increased and, as a result, have strongly transformed rural areas in Chile (Challies and Murray 2011; World Bank 2011). The non-traditional agricultural export (NTAE) strategy was implemented in the late 1970s and turned out to be very effective. After only two decades, Chile became a leading exporter of farmed salmon and of fresh and processed fruits. In 2004 Chile established a new agricultural and trade policy with the aim of developing and enhancing the agricultural export sector and establishing Chile among the top 10 exporters of agricultural products world-wide by the year 2015. Along with the United States, Europe has emerged as one of the dominant export destinations for Chilean agricultural and food products (Challies 2010; Rivera Aedo and Lakner 2011; Otter and Theuvsen 2012). Besides Chile, other Latin American countries, such as Costa Rica and Guatemala, have also successfully introduced NTAE strategies. Hence, the strong focus on NTAEs can be seen as a widespread development between the 1970s and the early 1990s in Latin American countries with a less competitive manufacturing sector (Barham et al. 1992; Gwynne 1993).

There is still no clear answer as to whether standards exclude developing and emerging country producers from global value chains or not and, if not, whether producers benefit from the increased standardization of agricultural production or not. The empirical reality seems to be more complex than the strict dichotomy standards as catalysts for development vs. standards as barriers to trade suggests. Against this background, it is the aim of this paper to present the available knowledge on the general functions of certification systems in food supply chains and highlight their role in and impact on developing and emerging economies, which often play leading roles in emerging high-value food chains, both in Latin America and beyond.

2. Certification Systems and Standards in Food Supply Chains

"Certification is the (voluntary) assessment and approval by an (accredited) party on an (accredited) standard" (Meuwissen et al. 2003: 172). Neutral third-party audits by an independent certifying party that assess the compliance of a certifiable party, i.e., a farm or a firm, with a standard typically laid down in a systems handbook are at the heart of certification procedures. By means of regular monitoring and - whenever necessary - additional sampling, neutral inspection institutions, in many cases auditing companies, monitor major parts of or even the entire food supply chain. Firms successfully passing the audit procedure receive a certificate that can be used as a quality signal in the market (Luning and Marcelis 2009). The vast number of certification systems that have been established over the last one-and-a-half decades can be organized along various dimensions: standard setter, addressees, foci, objectives, geographical coverage, number of participants and supply chain coverage (Spiller 2004; Theuvsen and Spiller 2007).

With regard to the **standard setter**, one can distinguish between public and private standards (Jahn et al. 2003). Public standards can be defined by supranational organizations, such as the European Union, national or regional governments. Private standards can be laid down by customers, suppliers, norming institutions, inspection and certification bodies or nongovernmental organizations with such goals as fair trade or higher animal welfare standards. Furthermore, combinations are possible, for instance, when industry associations representing different stages of the food supply chain join forces to set a standard. In other cases, public-private partnerships have been established in

which governments, consumer organizations, producers and/or other interested parties collaborate to set standards.

Addressees of the certificates can be either other businesses or consumers, or both. Business-to-Business (B2B) standards are not communicated to the final consumers, who are often unaware of the existence of such standards although the standards typically represent major parts of a food supply chain. Business-to-Consumer (B2C) schemes address the final consumer by displaying a label on the products produced by certified farms and firms. B2C standards exist in large number but often (although not always) operate in market niches. Some schemes combine the B2B and the B2C perspectives. These mixed standards address not only consumers but also other businesses and often leave it up to the certified farms and firms whether or not to communicate with consumers through labeling their products.

The **focus** of certification schemes can be systems, processes or products (Pfeifer 2002). Quality management system audits seek to monitor the capability of farms or firms to deliver minimum quality standards. Process audits check the appropriateness of the design of critical business processes, such as product development, production (for instance, organic versus conventional farming or animal-welfare friendliness), processing, or complaint management. A product focus is applied when, for example, product awards are granted based on sensory tests.

The **geographical coverage** of certification schemes can be very diverse. The spectrum ranges from local standards, which affect only local producers and processors, to global standards, which are applied in various countries and continents. In recent years, formerly national schemes have started to internationalize and now include a growing number of farms or firms outside their home countries (Gawron and Theuvsen 2009). Geographical coverage often has a strong influence on the **number of participants**. Local or regional schemes seldom have more than a few hundred members, whereas large international schemes encompass more than 100,000 certified farms and firms.

Finally, **supply chain coverage** is also very diverse. Some schemes focus only on one stage of the supply chain, for example, agriculture or food processing. Other standards include several or even all the stages of the food supply chain.

3. The General Role of Certification Systems in Food Supply Chains

Food quality is a multi-faceted phenomenon including intrinsic - product safety and health, sensory properties and shelf life, reliability and convenience - as well as extrinsic - production system characteristics and environmental impact - aspects (Luning and Marcelis 2009). In some cases, consumers are only able to check important quality attributes after consumption (for instance, taste or tenderness); in information economics, such products are called experience goods. In other cases, consumers are not able to ascertain relevant quality attributes or are able to do so only at a (prohibitively) high cost; examples include food safety, nutritional value, organic production, animal welfare standards or region of origin (credence goods). Experience and credence attributes result in high information asymmetries since producers, processors and retailers are generally much better informed about the true quality of their agricultural and food products than consumers (Henson and Traill 1993). If customers lack credible information on product quality, this situation will probably result in market failure since customers are afraid of being exploited by utility-maximizing transaction partners (Akerlof 1970). In such cases, certificates granted after successfully passing independent third-party audits allow producers and processors to signal compliance with food quality standards and reduce the quality uncertainty of their potential buyers (Luning and Marcelis 2009).

Since agricultural and food products are so-called "necessary goods" with very inelastic demand curves (Hardes and Uhly 2007), information asymmetries result in not only financial but also health-related disadvantages for consumers. Therefore, there is a long tradition of food inspection initiatives at various government levels (municipal, regional, national, supranational; Grüne 1994, 2002). However, public administrations often lack the capacity and capabilities to consistently survey complex food supply chains. This has resulted in major food scandals, such as the BSE crisis in Europe. Several measures have been taken to address these deficits. First, there has been a paradigm shift in food legislation. Article 17 of General Food Law Regulation (EC) 178/2002 now stresses private responsibility for food safety and proposes that food business operators shall ensure that foods satisfy the requirements of food law (Streinz 2007). Second, certification schemes help to reduce quality uncertainty and information asymmetries and to secure more consistent food quality and safety. Even if the standards on

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which certification is based represent mainly a repetition of food law and good agricultural and manufacturing practices, the more regular third-party audits established by these systems contribute to greater food safety and a closer inspection of farms and firms (Theuvsen 2010). The private enforcement of legal regulations that were often inconsistently controlled by public authorities prior to certification might explain why many certified farms and firms perceive even minimum standard schemes that focus on checking compliance with food regulations as additional burdens (Gawron and Theuvsen 2007).

Certification schemes can also help producers, processors and retailers to differentiate agricultural and food products in the market. Differentiation is a competitive strategy that seeks to increase consumer loyalty and willingness to pay by creating product offerings customers will perceive as superior in comparison with undifferentiated products that compete only on price (Porter 1980). Product differentiation is typical of the large number of certification schemes addressing the final consumer by labeling agricultural food products. Differentiation can be based on such features as compliance with above-average process standards, for example, organic farming or higher animal welfare standards; guaranteed region-of-origin; traditional production methods; freedom from genetically modified organisms; or higher organoleptic qualities. Often two or more differentiating aspects are combined, for instance, region of origin, traditional production methods and higher organoleptic qualities.

Risk management is another motivation for supply chain actors to establish certification schemes and standards. The improvement of food safety by guaranteeing compliance with minimum quality standards and implementation of full-fledged traceability systems - a typical element of minimum standard certification schemes - helps to reduce quality uncertainties, especially with regard to credence attributes, such as freedom from microbiological risks, and the enormous cost of product recalls. These aspects are major drivers of firm investments into tracking and tracing systems (Heyder et al. 2012). Furthermore, reduced quality uncertainty decreases transaction costs, especially search and control costs (Williamson 1985). This effect also allows supply chain actors to keep the advantages of open market transactions and reduces the need to vertically integrate or cooperate more closely within food supply chains for food safety reasons (Schulze et al. 2006). As a consequence, the set-up costs and lower incentives of more strictly vertical-

ly coordinated chains are avoided, and the incentive and cost advantages of spot markets preserved (Porter 1980; Williamson 1991; Theuvsen 1997).

Finally, certification schemes help supply chain actors to meet societal demands with regard to ecological and social sustainability. Enterprises along the food chain are increasingly exposed to the public eye (Jansen and Vellema 2004). Highly visible supply chain actors, such as large producers of branded food products and retailers, are the main addressees of NGOs' and other stakeholders' demands for more sustainable practices in agriculture and food production (Heyder and Theuvsen 2009; Friedrich et al. 2012). Retailers in particular - often perceived as the "new masters of the food system" (Flynn and Marsden 1992) - have started to react to this external pressure by critically screening the sustainability of the food chains they source from. Certification schemes and standards have become common means of guaranteeing compliance with minimum sustainability standards, such as avoidance of child labor, fairness of trade relations or ecologically sustainable production practices.

In summary, the rapid proliferation of certification schemes and standards in food supply chains over the last one-and-a-half decades was a means to variety of ends. Reduction of quality uncertainty and information asymmetries, improved differentiation of agricultural and food products, improved risk management and traceability, and increased control over ecological and social aspects along food supply chains are among the most important of these. The worse the quality infrastructure, such as the public food inspection system, and the lower the ecological and social sustainability standards of an export country compared to the standards of the final market, the greater the importance of these factors becomes. Therefore, it is not surprising that GlobalGAP, founded in 1997 by the Euro-Retailer Produce Working Group (EUREP) for certifying fruit, vegetables and cut flowers imported from developing and emerging countries, has become one of the pioneers of the certification trend in agriculture and the food industry.

4. The Emergence of International High-value Chains: The Case of Latin America

International agricultural trade has long been dominated by commodity products. In this context, many developing countries emerged as exporters of bulk commodities that were consumed in large quantities in industrialized countries but could not be produced there. Soybeans, coffee, tea, cocoa, bananas and citrus fruits are typical examples. More recently, a new type of value chain has appeared in international agricultural trade, often referred to as high-value food chains, through which developing and emerging economies supply non-traditional agricultural products to industrialized countries. This development has received growing attention in agricultural economics research due to such aspects as its impact on rural development and the important role of supply chain design. Furthermore, the rise of international high-value chains after the introduction of NTAE strategies in many developing and emerging countries, for instance in Latin America, became a catalyst for the increasing importance of certification schemes and standards in food supply chains (FAO 2004; Ruben et al. 2007; Theuvsen and Voss 2012; Collins 1995; Challies and Murray 2011).

The export of non-traditional agricultural products is a political strategy that was implemented in many Latin American countries during the last 40 years. Between the 1970s and the early 1990s, many Latin American countries shifted from inward to outward oriented economic policies in order to increase economic growth. While the inward orientation was characterized by protectionist policies, import substitution industrialization, discouragement of foreign investments and technological nationalism, the outward orientation focused on trade liberalization, attraction of direct foreign investment and advancing technological capabilities. Larger countries, such as Mexico and Brazil, had relatively strong manufacturing sectors due to their large domestic markets and, therefore, had better opportunities to compete on the international market after making the change to outward oriented policies. Smaller countries, such as Chile, Costa Rica and Guatemala, with less competitive manufacturing sectors started increasing the export of agricultural products and also introduced the strategy of non-traditional agricultural exports (NTAE). In most cases, these non-traditional agricultural export products had not previously been produced in or exported by these countries (Gwynne 1993; Barham et al. 1992; Rivera Aedo and Lakner 2011). This development has been fostered by various national interest groups, such as Chile's Fundaciòn Chile, ProChile and

domestic conglomerates (Barton and Murray 2008). The Inter-American Development Bank (IDB) and other international organizations have often supported such activities in order to create foreign trade and new opportunities for employment and income in poor rural areas (Damiani 2000). The NTAE strategy has been actively promoted by national and international NGOs working in economic development. The World Bank, the FAO and USAID, for instance, have been involved and offered economic assistance (López 2010; Barham et al. 1992).

Most of the NTAEs are fish products and fresh fruits and vegetables. The types of NTAE differ between the Latin American countries. While Guatemala mainly exports snow peas, broccoli, berries, melons and flowers, Costa Rica focuses on exporting fish, shrimp, pineapples and horticultural products and Chile on salmon, table grapes, apples, pears, stone fruits, avocadoes, berries, kiwis and forestry products (Barham et al. 1992; Challies and Murray 2011). "The particular characteristics of these crops, such their perishability and the concentration of production in accordance with specific cycles, made it necessary to implement numerous innovations in production technology, organization, and coordination, as well as intensive training for rural workers" (Damiani 2000, p. 2). Additionally, these products are strongly affected by high quality standards (Collins 1995). To meet the demands of the private companies exporting the products to the foreign markets, producers need to meet a number of public standards, such as Guidelines of Good Agricultural Practice (GAP) and HACCP, and private standards, such as GlobalGAP (Unnevehr 2000; Henson and Humphrey 2010).

NTAE products are often produced by large and medium-sized farms, but sometimes by smallholders as well (Damiani 2000). Participation of smallholders in the production of NTAE products differs between countries and products. While the participation of small farmers in NTAE is decreasing in Chile and Costa Rica, due to inequalities in access to capital and market disadvantages, smallholders still play an important role in Guatemalan horticulture production, where a combination of patterns of land tenure, climatic conditions and labor intensity have prevented the exclusion of smallholders from the market (Barham et al. 1992; Damiani 2000).

5. Certification-based Food Safety Standards: Their Role in and Impact on Developing and Emerging Economies

Due to the important role of NTAEs for many developing and emerging economies, it is important to look at NTAEs in the context of the current dynamics in the area of food quality and sustainability standards. Especially with regard to non-traditional agricultural products, agri-food quality standards play an increasingly important role in global value chains. But since there is still no clear evidence as to whether certification-based standards function as catalysts for development or barriers to trade, it is worth having a closer look at existing knowledge about their specific roles in and impact on these countries and producers. This is especially relevant for many Latin American countries, considering that their agricultural systems are strongly based on NTAEs including large- and small-scale farmers.

Costs, competitiveness and trade

Compliance with food safety standards (FSS) represents relatively high costs for economic actors in developing and emerging countries - countries that are often characterized by a weak or even absent public quality infrastructure and ineffective enforcement mechanisms (Hobbs 2010). This creates a competitive disadvantage for producers from these economies compared to producers from more developed countries. Usually, producers have to start from scratch when adopting an FSS, and a substantial transformation of the farming system is required (Henson and Humphrey 2010). Developing and emerging economies often lack the administrative, technical and scientific capacities necessary for creating a standard compliance environment (Henson 2007). In a negative scenario, institutional weaknesses and relatively high compliance costs may lead to further marginalization of countries and already economically fragile farmers. From a value chain perspective, standards generally influence the organization of relationships within food chains. This can affect the distribution of welfare between countries and between supply chain actors (Maertens and Swinnen 2012). The reorganization of a chain and the introduction of new private governance mechanisms by lead firms can increase their bargaining power at the cost of actors at the lower end of the chain. Besides these structural difficulties faced by developing and emerging countries when complying with global private standards, adopting standards can also have positive ef-

fects. FSS are instruments for harmonizing global trade and reducing transaction costs, and there are incentives for compliance due to the benefits promised by export markets (Henson 2007). High implementation and compliance costs may trigger infrastructure investment and modernization, which in turn can promote value chain integration and trade flows (Hobbs 2010). Compliance with standards can lead to spillover effects into the domestic product, factor and labor markets with positive consequences for the competitiveness and performance of farms, firms and countries (Henson 2007).

According to Hobbs (2010), the general trade effects of standards depend on the extent of the asset-specific investment necessary for adoption, the status of the quality infrastructure in the given country, the competitive situation of the food retailing sector and the degree to which a standard is specific to a certain retailer (so-called proprietary standards, like Tesco's Nature's Choice[3]) or in wider use (so-called consensus standards, like GlobalGAP[4]). Proprietary standards may have a stronger trade reducing effect as compliance requires higher asset-specific investments compared to consensus standards. Without a 'risk-premium', trade relationships can be unstable due to the risk of ex-post opportunistic behavior on the part of the buyer (Hobbs 2010). The effect of opportunistic behavior might be stronger in developing and emerging countries, which are often characterized by a weak institutional and jurisdictional infrastructure. Private voluntary standards, especially consensus standards, may facilitate trade since compliance with one standard can give access to multiple chains and a considerable number of buyers and countries. This argument is important in a developing country context as producers have to take relatively higher hurdles because public food quality standard systems are frequently lacking. Henson (2007) sees one of the main challenges for developing countries in honing their ability to anticipate and influence trends in standard setting and adapt the necessary institutional environment while maintaining the country's competitiveness.

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[3] Tesco's Nature's Choice is a private, retailer-based standard that suppliers must comply with in order to access one specific UK supermarket chain.

[4] GlobalGAP is a voluntary and private retailer-based food safety standard assuring good agricultural practices. It is one of the most widespread private FSS and is therefore quasi-mandatory for several countries. This standard is of particular interest for the present paper.

Determinants of FSS Adoption

In order to better understand the role of certification-based FSS in global agri-food chains and their effects on the involved actors, it is necessary to clarify what drives standard adoption. The adoption of a private FSS can be compared to the adoption of an organizational innovation (Herzfeld et al. 2011) and is usually related to a specific marketing channel choice. According to Reardon et al. (2009), two factors determine the decision of farmers to adopt a FSS and thus choose a specific marketing channel: First, incentives - namely the net product price and the relative costs and risks of compliance - influence the decision-making process, and second, capacity - more specific farm assets, collective capital (cooperatives or farmers group capital), and access to public and private financial and technical assistance. Furthermore, farm-household characteristics, the production system and the market context (chance of success, market distance, etc.) also influence a farmer's choice (Zúñiga-Arias and Ruben 2007).

In a cross-country comparison, Herzfeld et al. (2011) find that geographic and historical condition, infrastructure, sectorial characteristics, institutions and gross domestic product influence GlobalGAP adoption. Private certification-based FSS may continue to play an important role. In their study on traceability systems in Portuguese pear production, Souza Monteiro and Caswell (2009) find that standard adoption is driven by the producer's orientation towards exports, involvement in producer organizations and vertical integration in the chain through contracts. Kersting and Wollni (2012) show that education, farm technology, marketing channel prior to adoption, training and certification with another quality scheme (path dependency) matter in GlobalGAP adoption among small-scale Thai horticultural producers. Similar results by Asfaw et al. (2009) confirm the importance of education, access indicators and farm wealth for quality standard adoption among Kenyan small vegetable farmers. Lemeilleur's (2012) findings on GlobalGAP adoption among Peruvian mango farmers indicates the positive effect of production specialization, access to communication infrastructure (cell phones), group membership and farmers' contract history; distance to the exporter's plant, in contrast, negatively influences standard adoption. From a value-chain perspective it can be argued that farmer compliance is more likely in a concentrated sector with relatively powerful buyers, who have the opportunity to sanction deviant behavior, resulting in fewer marketing options (Müller 2009).

Conceptually it makes sense to distinguish between factors - or requirements - that economically and technically enable a farmer to adopt a standard and factors that influence the farmer's willingness to comply with a certain FSS (ability to adopt vs. willingness to adopt). In addition to the factors mentioned above, power relationships, competition and sector concentration, trust and risk play important roles in farmers' willingness to adopt a standard. Thus, we can assume that the decision is made in a two-step process. First, farmers decide whether or not they are able (concerning their assets and technological and economical capacities) to adopt the standard. If so, they then decide whether or not they are willing to do so. These considerations are particularly important since FSS adoption does not necessarily include a price premium for the producer as is the case in systems such as fair trade or organic. Usually, FSS adoption - especially among small farmers - is only possible through technical and financial support from donors and exporters. Without this support, ability and willingness to adopt might be relatively low among asset-poor small farmers.

Little is known about adoption dynamics because certification-based private FSS are a relatively new phenomenon for many developing and emerging country producers. Are small farmers able to comply with a standard over time, even in the absence of external support? Is standards adoption economically viable over time?

FSS certification and sourcing from smallholders

Smallholder certification leads to increasing costs for exporters as they are usually responsible for implementation, monitoring, compliance and running the quality management system (Henson and Humphrey 2010). Given the high cost of implementing and complying with standards, why do exporters continue to source from smallholder farmers? From an economic perspective, exporters' decisions depend on the incentives provided by the channel that requires certification (price, costs and risks) and the financial and managerial capacity of the firm. The likelihood of adoption increases with the payoff to quality and company capacity and decreases with relative costs (Reardon et al. 2009). From an exporters' perspective, sourcing from smallholders comes with higher transaction and capital costs. However, even if they have to bear all or most of the costs of certification, exporters may prefer to buy from small farmers since lower labor costs can outweigh missing economies of scale. Small farmers can overcome the scale problem with collective action initiatives. Furthermore, offering resource-providing con-

tracts and training can help to overcome small farmers' lack of skills. Exporters must also take into consideration that sourcing from larger farmers can be riskier, as they have more sales options. There may also be fewer large-scale farms to work with, as large-scale farming can be limited by land constraints. Finally, promoting small farmers can be a political strategy, which also makes it attractive to exporters (Reardon et al. 2009; Henson and Humphrey 2010).

Economic impacts of FSS

From a development perspective, the possible socioeconomic impact of adopting food safety standards is of special interest. Theoretical considerations lead to the assumption that standards adoption and hence integration into high-value chains may positively influence farm income. Small farmers may benefit through higher prices as buyers have a high interest in locking in suppliers due to the asset-specific investment buyers usually undertake in covering certification costs. Even if they do not receive a higher price, farmers may receive higher net prices through resource-providing contracts or benefit from having lower marketing risks as adoption of FSS leads to closer supplier-buyer relationships through formal or informal contract systems (Reardon et al. 2009). On the export firm level, Henson et al. (2011) show that certified firms have relatively higher export revenues. Colen and Maertens (2011) find evidence among Senegalese firms exporting to Europe that GlobalGAP adoption leads to more stable exports and longer export seasons. Employees, too, seem to benefit through longer labor contracts. In the case of the Kenyan horticulture sector, Asfaw et al. (2009) see a positive effect of certification on farm financial performance. For lychee producers in Madagascar, Subervie (2012) finds that GlobalGAP adoption has no significant effect on the prices received, but that it does have a significant positive influence on the quantities sold. In this case, certified farmers sell significantly larger quantities to their exporters than non-certified farmers. Besides income effects, Minten et al. (2009) see benefits for Malagasy farmers supplying European supermarkets in shorter lean periods, improved technology adoption, better resource management and productivity spillovers to staple crops. Maertens and Swinnen (2009) analyze the effects of standards on the fresh fruit and vegetable sector in Senegal and show that the ways in which rural farm households are integrated into global value chains are changing; they seem to benefit increasingly through labor markets rather than through product markets.

6. Conclusions

The last one-and-a-half decades have witnessed the broad dissemination of - usually private - certification systems and standards in food supply chains. Due to intensive empirical research, the reasons for this development are quite well understood. Simultaneously, a fundamental transformation of the world agricultural system has taken place. The emergence of NTAEs is an important element of this transformation process. Latin American countries have played a very active and often a leading role in creating new market segments, which could help to increase agricultural exports, create new job opportunities and increase income. In these NTAE chains, private certification-based standards play a pivotal role and have often proven essential for successful delivery to export markets.

Despite the high importance of private certification-based FSS in international agri-food trade, evidence of their role in and impact on developing and emerging economies is still not very systematic. Also, with regard to the Latin American export sector, evidence of the impact of private standards on NTAE producers is still very limited. Nevertheless, in the presence of an ongoing transformation of the global agri-food system, it is vital to understand standard dynamics in supply chains between developed countries, on the one hand, and developing and emerging countries, on the other. Especially in NTAE chains, many smallholders are involved and therefore have to be able to adapt to the requirements laid down in private FSS.

NTAE chains are as diverse as Latin American countries. Therefore, it is difficult to come to general conclusions. In any case, more research is required to better understand the role of certification standards in NTAE chains and especially the effects on smallholders. Some of the questions that should be tackled in future research include the following:

- What are the interdependences between private certification standards and the public quality infrastructure? Do they replace each other, or are there positive feedback effects that make both systems more effective and efficient?
- What is the role of certification systems such as ChileGAP or MéxicoG.A.P.? Do we face a re-nationalization of standard setting? How does harmonization between various national and international certification standards currently take place? And

how does the increasing trade between emerging countries (South-South trade) affect food quality systems?

Finally, the conditions under which smallholders can participate in international agrifood chains governed by private certification systems and the various socioeconomic effects of standard adoption still clearly deserve more attention and more in-depth research. Future studies should more thoroughly address the specifics of various NTAE chains (for instance, fresh versus processed products, food versus non-food items, plant products versus products of animal origin). Furthermore, the large heterogeneity of Latin American countries with regard to their political, economic, social, technological, ecological, legal and market environments should thoroughly be taken into account.

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Food safety standards in the Guatemalan fresh pea sector: The role of financial literacy in technology adoption

This paper is a joint work with Prof. Dr. Ludwig Theuvsen

1. Introduction

In international trade with fresh fruit and vegetables, private certification schemes have become a predominant instrument for assuring food safety and quality (Unnevehr 2000, Reardon et al. 2009). This development has fueled a controversial debate in research and practice about the implications for farmers in developing countries. Compliance with international (and increasingly also national) quality and food safety standards is seen as an important asset for participating in agricultural value chains. Standard adoption is associated with more efficient and sustainable production as well as economic benefits. The relatively low adoption of private food safety standards and the weakness of public quality assurance institutions in many developing countries remain in sharp contrast to this tendency.[5] This is a concern because non-adoption could lead to further marginalization of already small, asset-poor farmers (Maertens and Swinnen 2012). In contrast, significant benefits for small farmers may be expected once they overcome constraints and comply with international food standards (Anders and Caswell 2007). Hence, identifying factors that favor or constrain the adoption of food standards is of empirical and practical relevance.

Existing studies stress the role of endowment factors and access indicators in the standard adoption process. A number of factors - farm land and non-land assets, collective capital and access to resources like credit, assistance and information - help farmers undertake the necessary monetary and non-monetary investments (Reardon et al. 2009; Asfaw et al. 2009; Handschuch et al. 2013; Hansen and Trifković 2014; Kersting and Wollni 2012; Subervie and Vagneron 2013).

Standard adoption is an investment decision: farmers have to decide how to allocate their capital, land and family labor. Process standards lead to changes not only in agricultural production but also in farm management, and complying with the criteria requires specific financial and managerial abilities. It might be easier for farmers with more business-related skills, like financial literacy, to comply with food safety standards as they know how to use the information and adapt to new requirements. Standard adoption is also often related to credit access. Having a higher level of financial literacy

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[5] In Guatemala, GlobalGAP is adopted by less than one percent of fresh vegetable producers.

might help farmers to use this access more effectively. However, focusing only on access to resources and endowment factors might not be sufficient to explain the adoption decision. To the best of our knowledge, there is no empirical literature that considers the role of financial literacy in technology adoption or standard adoption in particular. Thus, this study contributes to the standard adoption literature by investigating whether financial literacy influences technology adoption by small farmers in developing countries.

In this paper, we examine the case of GlobalGAP adoption among small pea producers in the Guatemalan highlands. In this sector, sanitary and phytosanitary violations are prevalent problems and form one of the primary causes of export restrictions. In the absence of an effective public quality infrastructure, private investment in food safety and quality has become vital to securing Guatemala's role as a leading exporter of fresh peas. We use cross-section data from 277 pea farmers using a control-group design. The data was collected in 2012 using a stratified random sampling strategy. Descriptive results indicate that adopters and non-adopters differ in their level of financial literacy. Estimates from a bivariate probit model suggest that financial skills positively influence standard adoption. Our results hold practical implications. Acknowledging the importance of certain skills in the adoption process enables interventions to be more effectively tailored to bring farmers to adopt standards.

The remainder of the paper is structured as follows. First, we discuss the literature on the role of financial literacy in investment and technology adoption behavior. Next, we describe our research background, data and sampling strategy. After introducing our methodology in section four, we present the descriptive results in section five. In section six, we present and discuss the econometric results. The paper finishes with our conclusions.

2. Financial literacy and the adoption of process innovations

Financial literacy

Stated simply, financial literacy describes "a person's competency to manage money" (Remund 2010, p. 279). However, financial literacy embraces a variety of dimensions, such as financial knowledge, communication, financial management and decision mak-

ing, and planning (ibid.). Financial literacy is a skill that helps individuals better evaluate their personal economic situation and more effectively wield financial information in order to make the best possible decision based on their personal situation and preferences. The concept stresses the importance of the capability of individuals to use access to financial resources and financial information for their economic well-being.

Empirical evidence from developed countries suggests a positive relationship between level of financial literacy and economic decision making. Higher levels of financial literacy are associated with investments in pension funds (Lusardi and Mitchell 2005), stock market participation (van Rooij et al. 2011; Almeberg and Widmark 2011; Behrmann et al. 2010) and investments in financial products (Brown and Graf 2013). In spite of this relationship, few studies consider financial literacy in the context of developing countries. Gaurav et al. (2011) show that financial literacy training for farmers increases the take-up of index-based weather insurance. Drexler et al. (2014) find that improved financial and management knowledge has a positive effect on business outcomes among small businesses in the Dominican Republic. Cole and Sampson (2011) conclude that there is strong correlation between financial literacy and financial market participation in India and Indonesia.

Education, cognitive skills and technology adoption

In order to understand how financial literacy could affect standard adoption, we examine the literature on education, cognitive skills and technology adoption. Financial literacy is assumed to have an effect on technology adoption similar to that of education and cognitive skills (Gaurav and Singh 2012). The literature on the effect of education on the adoption of agricultural innovations in developing countries is very broad, and most adoption studies use education (in years of schooling) as a control variable (Feder et al. 1981; Foster and Rosenzweig 2010).

So, what are the paths through which education influences behavior? It is useful to distinguish between the cognitive and non-cognitive effects of education (Appleton and Bahiluta 1996). The cognitive effects of education embrace the formation of general skills, such as literacy and the transmission of specific knowledge. Non-cognitive effects include preferences and changes in attitude (e.g., being open to innovations and changing preferences). Skills like numeracy or literacy help farmers in their everyday

business (e.g., in using inputs based on the recommendations and computing the adequate dosage for their plots). It also helps them to make planning decisions relating the economic future of the farm (how to allocate family labor or whether to use a loan for investment). Non-cognitive effects influence farmers' attitudes towards new technologies, among other things.

Through such cognitive and non-cognitive effects, education influences farmers' allocative ability. Allocative ability is important for adjusting to change (Feder et al. 1981). There is general agreement in the literature on the important role of human capital in dealing with the disequilibrium effects that result from the introduction of a new technology (Feder et al. 1981). Foster and Rosenzweig (1995) conceptualize three concrete channels through which education influences technology adoption. First, more educated farmers are wealthier farmers and hence are better endowed to adopt new technologies (income effect). Second, more educated people have better access to information as their educational level helps them to better gather, process and use relevant information (information effect). Third, more educated people are better at and more open towards learning new things, which is essential in technology adoption (learning effect).

Education measured as attainment in school gives an incomplete picture of the role of skills and abilities in technology adoption. In many developing countries, schooling rates are very low or the quality of education is poor (Jolliffe 1998; Hanushek and Woessmann 2008). Knowledge and skills are mainly acquired through informal channels (van Rooij et al. 2011). Farmers may learn from their peers, through extension services, through learning-by-doing or through their cultural background. Examining the role of skills in innovation adoption better reflects the complexity of education, schooling and learning. In considering the role of financial literacy in farmers' innovation adoption behavior, we contribute to a deeper understanding of the role of human capital in the innovation adoption process of small farmers.

Financial literacy and standard adoption

Considering the aforementioned literature on education and cognitive skills, we assume financial literacy to affect standard adoption through several channels. First of all, adopting a standard is an investment decision. Farmers have to decide today on how to allocate farm resources, capital and labor in order to obtain benefits in the future. Ex-

porters often bear most part of the certification and investment costs for small farmers. Of course, farmers invest opportunity costs since they attend training and often have to cope with a more labor intensive production process. Furthermore, exporters often intend to reduce their support over time, so farmers need to know whether they have the necessary skills to comply with the standard without support in the future.

Farmers might also be required to undertake some small on-farm investments themselves, often with the help of a loan. The inputs provided often come in the form of a loan. So farmers need to have a solid understanding of credit management. Standard adoption often makes farming more labor intensive, especially since process standards require the recording and control of all the production processes. When considering adoption, farmers need to evaluate the economic and financial consequences of standard adoption for their farms' economic and financial situation. Proper financial skills are therefore important for managing food safety and quality standards at the farm level.

In order to understand how financial literacy influences the adoption process, we rely on the argumentation laid down in the previous section. Financial literacy can have cognitive and non-cognitive effects. Farmers with better financial skills might have more capital and credit to undertake the on-farm investments that are sometimes necessary. High financial literacy is associated with a greater availability of unspent income and a higher spending capacity (Klapper et al. 2012).

Farmers with high financial literacy learn faster and can use information (e.g., on required input use) in a more efficient manner. Low levels of financial literacy may imply higher costs of information gathering (Almeberg and Widmark 2011). Farmers with better financial literacy skills might learn faster. Farmers with better financial skills might also have a more positive attitude towards new investments as they are more confident about their ability to manage change. Non-investment could be a strategy for avoiding mistakes caused by missing knowledge and skills (Almeberg and Widmark 2011). The better the level of financial literacy, the better a person may be able to exploit his or her own resources and the more successful that person will be in adopting innovations in comparison to persons with a lower level of financial literacy. Klapper et al. (2012) argue that high financial literacy levels come with a better ability to deal with shocks, such as a high inflation rate, an unforeseen change in interest rates, and the breakdown of an exporter or even a microfinance institution. In summary, farmers with

a higher level of financial literacy have a better allocative ability and are better equipped to adjust to the disequilibrium that is caused by the introduction of a new technology or situation.

3. Research background

3.1 GlobalGAP and food safety in Guatemala

GlobalGAP is the most common private food safety standard for fresh fruit and vegetable trade that affects developing countries. GlobalGAP is a pre-farm gate standard that requires the implementation of good agricultural practices as well as quality and food safety measures. This process standard is non-mandatory and applies exclusively to business-to-business relationships. It is generic in nature and sets norms that are slightly above the public regulations of the EU and the US. GlobalGAP is quasi-mandatory for supplying to several big European retail chains. In order to make GlobalGAP more accessible to small farmers, there are two certification options: individual certification and group certification. For group certification, producer groups run a joint quality management system and can share some investments, like collection centers and auditing costs. In the recertification process, only a random fraction of the group is audited, which significantly reduces certification costs. Each producer holds a contract and is obliged to market certified products exclusively through the group (see GlobalGAP general regulations 2013).

Guatemala is a country with a very low institutional capacity in food safety and quality. This challenges public and private compliance efforts and increases the costs for complying with international norms (Henson 2007). Food safety and quality problems have been widespread (Norton et al. 2003) and are jeopardizing the international competitiveness of the country in non-traditional agricultural exports (Julian et al. 2000). Pea exports in particular have experienced high detention rates due to microbiological contamination and pesticide overuse (Henson 2007). These detentions have considerable economic effects, as the export-oriented sector is dominated by capital-poor smallholders.

For several years, the non-traditional export sector has been using GlobalGAP increasingly as an instrument to reach conformance with international norms, and today it is

the most important food quality standard for Guatemala. In August 2012 there were 1,233 certified farmers in Guatemala (GlobalGAP 2012). Over 800 of the certificates are held by pea producers. GlobalGAP-certified production is still marginal: Less than 1 percent of fresh fruit and vegetable producers in the country are certified by Global-GAP.

3.2 Data

Between August and October 2012, we surveyed a sample of 277 fresh pea farmers in the departments of Chimaltenango and Sacatepéquez in the Guatemalan highlands.[6] We collected information on the socio-demographic and socio-economic situation of the farm-households as well as on agricultural production and marketing, certification and financial literacy. The recall period was from August 2011 to July 2012. The financial literacy section is based on widely used survey questions (OECD INFE 2011; Atkinson and Messy 2012). Six multiple choice questions cover general knowledge of numeracy (percentage calculation and division) and more specific financial knowledge (inflation, interest and compound interest calculation). We presented the questions as a small quiz rather than a test to the farmers to make them feel more comfortable. If a farmer was not able to answer the two general numeracy questions we did not ask them the detailed financial literacy questions. The test questions were then coded as "does not know".[7]

We use a stratified random sample. The treatment group consists of 152 farmers certified under option 2 (group certified farmers). The first control group consists of 65 non-certified farmers who are members of a farmer group. The selection of the farmer groups was a non-random process since we had information on farmer groups from collaborating exporters and one nongovernmental organization. Within the farmer group we selected certified and non-certified interviewees randomly from the member list. GlobalGAP certification within the farmer group is still an individual decision. None of the groups we dealt with for the study had reached full certification of all members. Since some of the information on certification turned out to be outdated, we also have

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[6] These two departments account for around 90% of the national pea production. They are both relatively close to the capital, Guatemala City, which favors the production of export crops due to better access to modern infrastructure and lower transportation and transaction costs.

[7] See Appendix A1 for a detailed presentation of the question used in the financial literacy test.

ex-certified farmers in our sample. Since these farmers decided to adopt in the past, they are included as adopters in our model. The second control group consists of 60 non-certified and non-organized farmers. This group sells to intermediaries or on the spot market, where there is no standardized quality selection of the product. We included this group to be able to control for group level effects. The second control group was selected by random walk method.

We use information on transportation costs and distance to the next marketing center; this data was provided by the International Food Policy Research Institute (IFRPI).

4. Methods

4.1 Empirical model of the adoption process

We model the adoption decision based on a utility maximization framework. We assume that a utility maximizing farmer opts for GlobalGAP adoption if the expected utility of adoption is higher than the expected utility of non-adoption. A farmer's utility is influenced by socioeconomic and contextual variables that also influence the decision to adopt GlobalGAP.

The utility function for GlobalGAP adoption takes the following form:

$$(1) \qquad U_i = X_i \gamma + u_i \,,$$

where U_i describes the utility of farmer i. X is a vector of contextual and socioeconomic variables assumed to influence utility. We cannot directly observe a farmer's utility of adoption as it is a latent variable. What we can actually observe is the farmer's choice between adoption and non-adoption. Based on the utility framework, we assume that a farmer adopts if the utility of GlobalGAP adoption GG_i is greater than zero, and does not adopt if it is not:

$$(2) \qquad GG_i = \begin{cases} 1 \; if \; U_i \; > 0 \\ \\ 0 \; if \; U_i \le 0. \end{cases}$$

Assuming a linear relationship, the adoption of GlobalGAP can therefore be described as

$$(3) \qquad GG_i \; = \; \beta_{i1} \, X_i + \beta_{i2} \, FL + \, u_i,$$

where GG_i is a binary choice variable taking the value 1 if the farmer has adopted GlobalGAP and 0 if not, X_i is a vector of observed farm and non-farm characteristics that are assumed to influence the decision, FL is our variable of interest - financial literacy - and u_i is the unobserved error term we are trying to minimize.

Small farmers have access to GlobalGAP adoption through group certification. Only those farmers who decide to be members of a group actually have the option of standard adoption. To acquire consistent estimates, we need to consider the two related decisions: first, the farmer decides whether to join a farmer group. If the farmer opts for membership, he or she can decide whether or not to adopt the standard. See figure 1 for an illustration of the decision process. We assume that non-group members do not face the decision of GlobalGAP adoption as individual certification entails very high costs.[8]
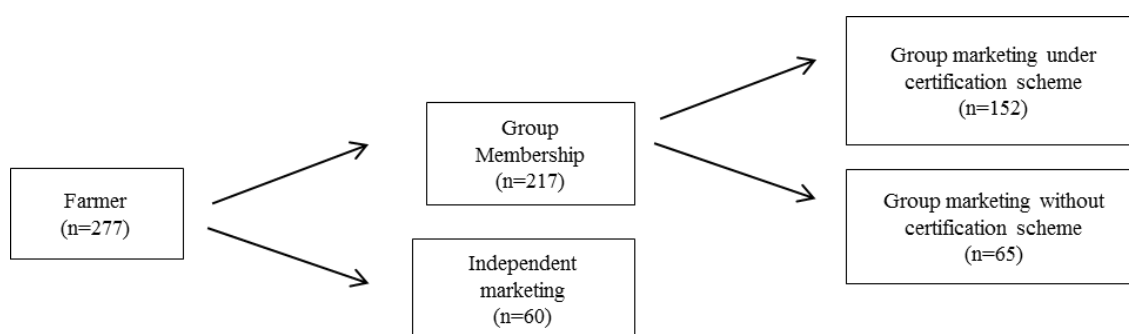
Figure 1 Conceptual framework of GlobalGAP adoption

It might be the case that the same unobservable factors drive both group membership and GlobalGAP adoption. We could think of motivation to succeed in economic terms as a driving factor for group membership and GolbalGAP adoption alike. This could cause a selection bias. Without correcting for this bias, the model would give inconsistent estimates.

To control for possible selection bias, we opt for a bivariate probit model, which allows for correlation in the error term (Greene 2003). If no correlation is found between the two error terms, then no selection bias exists and two independent probit models can be

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[8] Among pea producers, the only option 1 certificates are held by exporter-owned farms.

used to interpret the results. If significant correlation exists between the two error terms, then the bivariate model corrects for the selection bias in the estimates.

The following bivariate model is adapted from Greene (2003) and Kersting and Wollni (2012):

(4) Selection equation:

$$y_{i1}^* = x_{i1}' \beta_{i1} + \varepsilon_{i1}, \qquad y_{i1} = 1 \; if \; y_{i1}^* > 0, 0 \; otherwise.$$

(5) Outcome equation:

$$y_{i2}^* = x_{i2}' \beta_{i2} + \varepsilon_{i2}, \qquad y_{i2} = 1 \; if \; y_{i2}^* > 0, 0 \; otherwise.$$

$$E\left[\varepsilon_{i1}|x_{i1}x_{i2}\right] = E\left[\varepsilon_{i2}\mid x_{i1}x_{i2}\right] = 0,$$

$$Var\left[\varepsilon_{i1}|x_{i1}x_{i2}\right] = Var\left[\varepsilon_{i2}\mid x_{i1}x_{i2}\right] = 1,$$

$$Cov\left[\varepsilon_{i1}\varepsilon_{i2}|x_{i1}x_{i2}\right] = \rho.$$

y_i^* represents the unobserved, latent variables. y_{i1}^* is the utility of being in a farmer group and y_{i2}^* is the utility of being certified with GlobalGAP. β_i' are parameter vectors, x_i' are vectors of exogenous explanatory variables and ε_i are the error terms with zero mean, unit variance and correlation ρ. The model is tested under the null hypothesis $\rho{=}0$, meaning no correlation between the error terms and no selection on unobservable factors. If ρ is found to differ significantly from 0, then we have selection bias in our model.

For our decision model, the following holds:

$y_{i1} = 1$ if the farmer i is member of a farmer group, 0 otherwise

$y_{i2} = 1$ if the farmer i has adopted GlobalGAP, 0 otherwise

We can only observe $y_{i2} = 1$ if $y_{i1} = 1$. Only if a farmer is member of a farmer group can he or she actually face the adoption decision.

We oversampled GlobalGAP-certified farmers. In order to control for biases caused by the sampling design, we used probability weights. We used the inverse of the probability of being included in the sample due to the sampling design. We estimated the population size of our sampled group based on data provided by GlobalGAP and the 2004 Guatemalan agricultural census (Instituto Nacional de Estadísticas 2004). We use robust standard errors.

4.2 Principal component analysis

Principal component analysis (PCA) is a multivariate statistical method. It is used to reduce a number of variables that describe the same latent phenomenon into smaller dimensions. From an initial set of n correlated variables, PCA creates uncorrelated components. These components account for most of the variance in the data. Each extracted component is a linearly weighted combination of the initial set of variables. For a set of variables X_1 to X_n the principal components are

$$(6) \quad PC_1 = a_{11}X_1 + a_{12}X_2 + \cdots + a_{1n}X_n$$

$$\cdots$$

$$(7) \quad PC_m = a_{m1}X_1 + a_{m2}X_2 + \cdots + a_{mn}X_n \,,$$

where a_{mn} is the weight for the mth component and the nth variable (Vyas and Kumaranayake 2006). The weights of the principal components are the eigenvectors of the correlation matrix. The eigenvalue of the eigenvector is the amount of explained variance (Vyas and Kumaranayake 2006; van Rooij et al. 2011). The first component accounts for the largest amount of the underlying information of the variables used (Kolenikov and Angeles 2004). It represents the linear index of all the variables used in the PCA. The other components are not correlated with the first component. They explain additional, but smaller, variation in the data. PCA assigns weights to the variables according to how much each contributes to the variation in the data (Langyintuo and Mungoma 2008). We used unrotated PCA to construct a financial literacy index and a farm asset index. Using an index has proved to be useful by other studies in financial literacy research (van Rooij et al. 2011; Behrmann et al. 2010) and poverty research (Vyas and Kumaranayake 2006).

For financial literacy, the first extracted component accounts for almost 70% of the variation (table A-1 in the appendix). The factor loadings for the first component all have the same sign and are almost equal in magnitude (table A-2, appendix). The Kaiser-Meyer-Olkin (KMO) criterion of sampling adequacy tests whether the data used is suitable for PCA (see table A-3 in the appendix). The overall KMO score is higher than 0.8, which is considered very good. Bartlett's test of sphericity tests whether the correlations between the variables used are significant. The test indicates that we can reject the null

hypothesis of zero correlations between the variables. We used the first component to construct the financial literacy index.

The same procedure was applied to the 13 variables associated with farm assets. The KMO results suggest that we can perform factor analysis, albeit the value of 0.56 is lower than in the financial literacy index. Bartlett's test indicates that the data has enough correlation in order to perform PCA (see tables A-3 to A-5 in the appendix). The farm asset index is a proxy for the asset endowment of the farm household (as we do not have the necessary information in our dataset it is not a proxy for wealth).

5. Descriptive results

5.1 Sample characteristics

In tables 1 and 2, we present the descriptive statistics. We compare the means of certified and non-certified farmers for several variables of interest and use a t-test to check whether there are statistically significant differences in mean between the two groups.

The farmers are mainly indigenous: Only around 6% in either group state that their mother tongue is Spanish. The main language in the export business and in the (public or private) extension infrastructure is Spanish. Not speaking proper Spanish might increase information asymmetries, thus disadvantaging indigenous farmers in the adoption process.

Almost two-thirds of the farm household members are to some degree involved in farming activities, which means that we are dealing with family farms. The average off-farm income per capita in a year is relatively low and does not translate to the minimum wage per month.[9] The average land size and average hectares owned puts both groups into the category of subsistence farmers with less than seven hectares of land (Instituto Nacional de Estadísticas 2005).

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9 The minimum wage per month in Guatemala in 2012 for non-farm activities was 2,074 Guatemalan quetzals. (See http://www.leylaboral.com/guatemala/hotlinks/salariominimo.htm, accessed 11.11.2014.)

Table 1 Sample characteristics

	Ever certified	Never certified	Differences
Farm household and farm characteristics			
Age (head)	45.118	43.408	-1.71
Years of education (head)	4.691	4.592	-0.1
Mother tongue (0 = Spanish)	0.059	0.064	0
Total household members	6.217	5.88	-0.34
Members working on farm	3.77	3.656	-0.11
Members working off-farm	1.382	1.384	0
Total off-farm income	10,654.974	9,510.408	-1,144.57
Off-farm income per capita (quetzals)	1,867.106	2,092.827	225.7207
Total farm size in ha	1.644	1.172	-0.47**
Land owned in ha	1.446	0.957	-0.49**
Land owned before 2009 in ha	1.005	0.556	-0.45**
Share of peas in % of productive land	37.589	37.207	-0.38
Land title (0 = no title)	0.783	0.688	-0.09*
Irrigation (0 = no irrigation)	0.224	0.168	-0.06
Irrigation in pea production (0 = no irrigation)	0.204	0.144	-0.06
Farm asset index	0.293	-0.364	-0.66***
N	152	125	

Differences in mean significant at $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Certified and non-certified farmers differ significantly in total farm size and in the amount of land they actually own. On average, certified farmers possess more land and work on larger farms. A significantly higher share of certified farmers possess an official land title. A formal land title is important for accessing the formal financial market and gives security over land holdings. Unsecured property rights might hinder investments. The two groups do not differ significantly in their technological level proxied by irrigation. However, only around 20% of the farmers use irrigation, which is not a very high share.

Certified farmers score significantly better on the asset index. The farm asset index incorporates various durable farm assets as proxies for the economic situation of the farm. The higher the score in the asset index, the better endowed the farm. Certified and non-certified farmers differ significantly in group membership. This is not surprising as we were targeting group-certified farmers. Non-certified farmers also include independent farmers. Just comparing group members, certified farmers have been group members for significantly longer time. This might hint at the role of positive trustful relationships

in the certification process. Significantly more certified farmers were working with an exporter before 2009. We took 2009 as a threshold as GlobalGAP certification became more widespread afterwards. Certified farmers scored significantly higher in the financial literacy index, our variable of interest.

Table 2 Sample characteristics continued

	Ever certified	Never certified	Differences
Organization			
Farmer group member (0 = no member)	0.98	0.52	-0.46***
Time of membership	6.538	4.189	-2.35**
Marketing			
Experience with buyer in years	5.183	6.161	0.98
Exporter before 2009 (0= no exporter)	0.428	0.152	-0.28***
Business skills			
Financial literacy index	0.391	-0.476	-0.87***
Experience in pea production in years	11.187	12.051	0.86
Access			
Distance to the next marketing center in meters	6,616.317	6,374.303	-242.0138
Transportation costs ($/kg)	0.0043417	0.0051357	.000794*
Altitude	2,216.782	2,212.607	-4.18
Savings (0 = no savings)	0.164	0.192	0.03
Remittances (0 = no remittances)	0.059	0.08	0.02
Conditional cash transfer (0 = no CCT)	0.191	0.216	0.03
Access to formal credit (0= no Access)	.355	.328	-.027
N	152	125	

Differences in mean significant at $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

The two groups do not differ significantly in distance to the next marketing center, whereas interestingly they differ significantly in transportation costs. Non-certified farmers have significantly higher transportation costs. This could indicate that certification is somehow related to lower transaction costs. Savings, remittances and conditional cash transfer are proxies for farm households' economic situation and access to financial resources. There are no significant differences in mean between the groups for these variables. The saving rate seems quite low among the respondents (16–19%). Only 5% of the respondents receive remittances. This is surprising as the area is known for having a high migration rate to the United States. But it could be that mainly male family

members migrate, and female members are probably not so involved in pea production and certification activities.

The conditional cash transfer program is designed for needy families. They receive a small subsidy when they comply with certain criteria, like sending kids to school and attending regular medical checkups.[10] Around 20% of the sample receives this subsidy. But it seems that not only necessity influences whether a family receives the subsidy; another factor is whether the public sector is present in the area. Thus, receiving the subsidy is an incomplete proxy for poverty. We do not see any systematic difference in access to formal credit between the two groups. Around one third of the sample has access to loans from formal sources such as banks or microfinance institutions.

Certified and non-certified farmers show no systematic difference in mean in farmer or farm household characteristics. But when it comes to variables related to farm characteristics, marketing activity, financial literacy and access, we see systematic differences between the two groups.
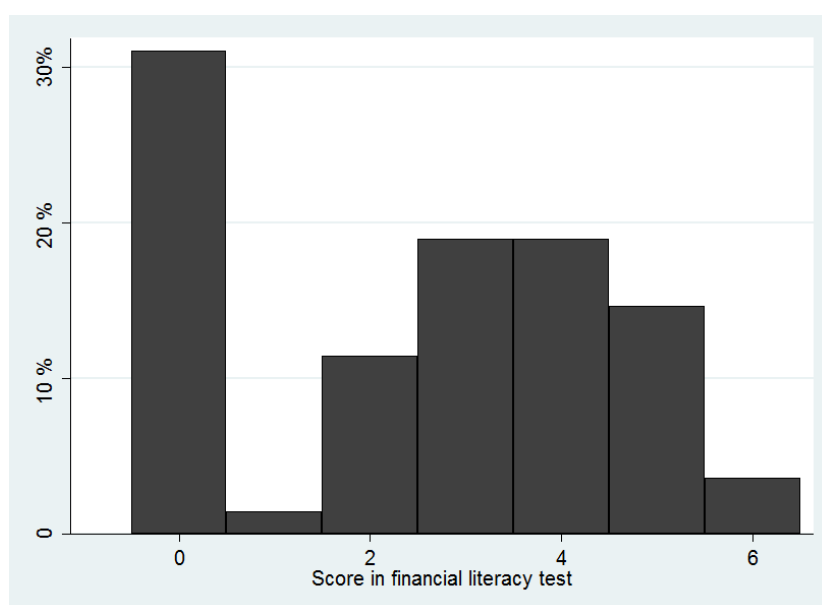
Figure 2 Distribution of correct answers in the sample N=277

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10 http://www.mides.gob.gt/programas-sociales/mi-bono-seguro, accessed 20.06.2014.

5.2 Financial literacy

Around one-third of the respondents did not answer any of the questions in the financial literacy test correctly (see figure 2). Among those who managed to answer at least one question, most of the respondents scored three or four correct answers out of six (18% respectively). The median score is three correct answers out of six.

In order to better understand the possible influence of financial literacy on standard adoption, we explore the characteristics of the financially literate farmers in our sample. We stratify our sample into farmers with high and low financial literacy according to their scores in the index.[11] We use a t-test to compare the differences in mean between the two groups. The statistically significant differences are presented in table 3.

We see that farmers with a better score in the financial literacy index are on average younger and have attended more years of school. Maybe the younger farmers did not only attend more years of school, but also benefitted from higher quality of schooling, which will have improved their skills in areas important to financial literacy (numeracy, literacy etc.).

Table 3 Characteristics of farmers with high and low financial literacy

	High FL	Low FL	Differences
Age (head)	42.900	45.626	2.73*
Education	5.492	3.898	-1.59***
Total off-farm income	11,846.385	8,628.075	-3218.31*
assetX	0.182	-0.218	-0.40**
Formal credit access	0.300	0.381	0.08
Member farmer group	0.823	0.728	-0.10*
Years of membership	7.018	4.645	-2.37***
GlobalGAP	0.646	0.463	-0.18***
Observations	130	147	

Differences in mean significant at * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

It is also assumed that younger farmers are more open to innovations and changing practices. It might also be the case that younger farmers have had more experience with loans or other financial products, which in turn would influence their financial literacy level. Thus, it might have been easier for younger farmers to acquire financial literacy skills.

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11 The cutoff point is the median: Scores below the median indicate low financial literacy; scores above the median indicate high financial literacy.

Farmers in the upper quintile of financial literacy have on average higher off-farm earnings and score on average better in the asset index. This reflects in part the higher educational level of highly skilled farmers: Education and skills are seen as strong determinants of earnings and wealth. In turn, financial literacy might also be influenced by income and wealth status. Interestingly, the two groups do not differ in any farm characteristics or access indicators, like access to formal credit. (We do not present the non-significant differences in table 3 due to space restrictions.) Highly financially literate farmers have a higher membership rate in farmer groups and length of membership tends to be greater. Group membership is associated with better access to information and extension services. There might also be better opportunities to learn from the experience of others. The GlobalGAP certification rate is also higher among highly skilled farmers.

The situation of financial literacy in our sample reflects the findings of other studies. In a review of studies dealing with financial literacy, (Lusardi and Mitchell 2014) find that low levels of financial literacy are associated with poorer and less educated households. Older people and women are less literate, self-employed individuals perform better than employed individuals and individuals living in rural areas tend to have lower financial literacy than those living in urban areas.

6. Estimation results

6.1 Determinants of GlobalGAP adoption

The selection equation of the bivariate probit model estimates the probability that a farmer will join a farmer group. The outcome equation estimates the probability of GlobalGAP adoption (see table 4). For a detailed explanation of the variables used in the adoption model see table A-6 in the appendix.

Group membership is positively influenced by the age of the farmer, farm assets and experience working with an exporter (Exporter before 2009). Per capita off-farm income, remittances, cell phone use, experience in pea production and transportation costs negatively influence farm group membership.

We cannot reject the null hypothesis of zero correlation between the error terms of the two equations since ρ differs significantly from 0. We performed a likelihood ratio test,

which confirmed that the bivariate model performs better than two independent models. Hence we rely on the bivariate model to interpret our results.

Table 4 Bivariate probit model with marginal effects

	Group membership		Global-GAP adoption			
	Coeff.	(s.e)	Coeff.	(s.e.)	Marginal effects[a]	(s.e.)
Age	0.0196**	(0.00972)	0.0126	(0.00851)	0.0019	(0.00130)
Gender	-1.039**	(0.451)	-0.745**	(0.380)	-0.111*	(0.0599)
Education	0.0282	(0.0469)	-0.00717	(0.0371)	-0.000572	(0.00527)
MembersOnFarm	0.0143	(0.0408)	0.0146	(0.0366)	0.0021	(0.00514)
Off_income	-0.000103**	(4.15e-05)	-3.08e-05	(2.19e-05)	-5.34e-06	(3.58e-06)
Ha owned before 2009	0.0877	(0.0738)	0.0562	(0.0625)	0.0085	(0.00889)
Land title	0.166	(0.226)	0.150	(0.191)	0.0217	(0.0263)
Irrigation	-0.257	(0.246)	-0.0688	(0.218)	-0.0123	(0.0301)
Remittances	-0.862**	(0.345)	-0.798**	(0.346)	-0.115**	(0.0531)
Conditional cash transfer	-0.328	(0.201)	-0.255	(0.173)	-0.0376	(0.0235)
Cell	-0.490*	(0.256)	-0.317	(0.212)	-0.0477	(0.0335)
BuyerFFV	-0.0111	(0.280)	-0.161	(0.243)	-0.0212	(0.0350)
TarmacRoad	-0.241	(0.206)	-0.0537	(0.171)	-0.0101	(0.0254)
FarmX	0.294***	(.880)	0.0945	(.7146)	0.034***	(0.0127)
Livestock_NR	-0.0366	(0.117)	0.113	(0.106)	0.0142	(0.0153)
Mother tongue	0.126	(0.458)	0.00356	(0.419)	0.00209	(0.0598)
Exporter before 2009	0.610***	(0.213)	0.624***	(0.167)	0.0893***	(0.0262)
Formal credit access	-0.275	(0.185)	0.190	(0.155)	0.0212	(0.0246)
Experience pea production	-0.0363***	(0.0124)	-0.0186	(0.0114)	-0.00290*	(0.00170)
Specialization	0.00345	(0.00650)	0.00149	(0.00502)	0.000239	(0.000728)
T_costs	-74.03**	(30.45)	-46.36**	(23.30)	-7.007*	(3.834)
FLX2	0.0591	(0.0477)	0.108***	(0.0399)	0.0149**	(0.00667)
Constant	2.961***	(0.742)	1.918***	(0.638)		
rho	1.483***	(0.210)				
Observations	277		152		277	

Wald test of rho=0: chi2(1) = 78.8103 Prob > chi2 = 0.0000
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
a: continuous variables at the mean value, binary variables at modal value

Unlike in other adoption studies, we do not find a significant effect from such socioeconomic variables as age, education, off-farm income, member working on farm and land size (Subervie and Vagneron 2013; Kersting and Wollni 2012). We find that male-headed households are less likely to adopt the standard than female-headed households. This result is contrary to the findings of similar studies, such as Handschuch et al. (2013).

Receiving remittances from a family member abroad significantly decreases the likelihood of adoption. This effect might result from the absence of family members of productive age. The remaining family members might not be productive enough to engage in certification-based pea production. Another reason could be that farm families do not see a necessity to upgrade agricultural production but may instead invest in non-farm activities.

The score in the asset index has a positive effect on GlobalGAP adoption, indicating that the better equipped a farmer is with farm assets, the more likely he or she is to adopt the standard *ceteris paribus.* This hints at a wealth effect also found by other studies (Kersting and Wollni 2012; Asfaw et al 2009). The farmers who are able to invest in assets may also be more able to undertake the necessary investments that are not covered by the exporters. If a farmer was already working with an exporter in 2009, this also increases the likelihood of adoption. Farmers with more experience in export markets are used to producing in line with certain quality standards and use this experience in the adoption process. This result is backed up by a study by FAO (2014): They identify pre-existing relationships with the export market as one important determinant of standard adoption. Experienced farmers are more likely to have detailed information about market requirements and future developments, which might also point to the role of trust and long-standing relationships in the certification process.

A farmer's score on the financial literacy index has a significant positive effect on GlobalGAP adoption. This finding confirms our initial assumption that financial literacy plays a significant role in the adoption decision. (For a deeper interpretation of the role of financial literacy, see the next section.) Experience in pea production influences GlobalGAP adoption significantly. Surprisingly, the effect is negative: Farmers with more years of experience in pea production are less likely to adopt GlobalGAP. More experienced farmers might be more conservative and less flexible in applying new

methods or reluctant to accept external advice. Transportation costs to the next market town also have a negative effect on our outcome of interest. The further away and the more remote a farm is, the less willing the farmer seems to invest in standard compliance. This result partly confirms results from similar studies, like that of Kersting and Wollni (2012). We refine the estimation of the distance effect using estimated transportation costs that take into consideration infrastructure and natural conditions. High transaction costs outweigh the benefits of certification for more remote farmers. Export companies may be less present in more remote areas as they also suffer from higher transaction costs in reaching those areas.

To interpret the magnitude of the estimated coefficients, we calculated the marginal effects of the probit model. For the bivariate probit model, the marginal effects are reported as joint probabilities for a success on both stages of the model (Group membership = 1 and GlobalGAP adoption = 1). For continuous variables the marginal effects are calculated at the means, and for dummy variables at the modal value of the variable. In our model female farmers are 11% more likely to be GlobalGAP adopters compared to male farmers. Receiving remittances decreases the adoption likelihood by about 11%. A one unit change in the asset score increases the likelihood of GlobalGAP adoption by 3.4%. If a farmer was working with an exporter in 2009, the adoption likelihood increases by 9%. Experience in pea production has a negative influence on adoption. The marginal effect is small: An extra year of experience in pea production decreases the likelihood by 0.3%. The reported marginal effect of transportation costs is relatively large. For a one unit increase in the financial literacy index, the likelihood of adoption increases by 1.5%.

6.2 Financial literacy and the adoption of GlobalGAP

We identified a significant positive effect of financial literacy on GlobalGAP adoption in the case of Guatemalan fresh pea farmers. To determine the magnitude of the effect, we interpret the marginal effect of financial literacy. A one-unit increase in the financial literacy index results in a 1.5% higher probability of adopting GlobalGAP *ceteris paribus*. For example, the index ranges from -3.6 to 2.6. If a farmer shifts from the lowest quartile of financial literacy to the highest (an increase of 3 units in the index), his or her

probability of standard adoption increases by 4.5%. A change from no financial literacy to the maximum level of financial literacy increases the adoption likelihood by 9%.

While financial literacy has a positive effect on GlobalGAP adoption, we do not find a significant effect of educational level on standard adoption. This result is interesting: It seems that the financial literacy test captures different skills than we do by including years of schooling.[12] Our descriptive results show that higher scores in financial literacy come with on average more years of schooling. We can assume that the skills necessary for standard adoption do not depend on the years a farmer has attended school. Schooling quality or informal learning might be important sources of the financial skills necessary for innovation adoption. Van Rooij et al. (2011) argue that level of schooling is an incomplete proxy for financial or economic skills. Lusardi and Mitchell (2014) see financial literacy as a result of human capital investments rather than the simple result of more years of formal schooling. Studies often do not find a significant effect of years of schooling on technology adoption since schooling quality is low in developing countries (Jolliffe 1998; Hanushek and Woessmann 2008).

Our regression result suggests that asset endowment is important for the adoption of GlobalGAP. We show in the descriptive results that farmers with higher financial literacy skills tend to score better in the asset index. Although the direction of causality is not clear (on the one hand, financial literacy might help build up assets and improve a farmer's economic situation or, on the other hand, having certain asset level may require improvement in financial skills), we see in the descriptive statistics that highly skilled farmers benefit from a better asset endowment, which increases their likelihood of adoption (income effect). Being a member of a farmer group is a prerequisite for certification. Membership comes with advantages for farmers in the form of improved access to extension services, information, inputs, loans etc. Higher financial literacy may help farmers to better use the information and advice necessary for the adoption process. Low cognitive skills are associated with higher information costs. Christelis et al. (2010), for example, find that the association between cognitive skills and stock market participation is driven by information constraints. Non-cognitive effects of financial

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[12] We also ran the model without the financial literacy index. The result was the same: Education is not significant.

literacy might also influence adoption behavior. Financial literacy might also influence a farmer's attitude towards certification schemes, for example, by giving more importance to planning in business and financial aspects. The findings of Burks et al. (2009) support our assumptions: They show that cognitive skills influence individuals' preferences.

Financial literacy could also influence standard adoption through the farmers' risk attitudes. Financial literacy might help them build resilience and become less vulnerable towards external shocks, like fluctuating input and output prices, inflation or interest rate changes. This ability might lower their risk aversion towards the adoption of new technologies where the future economic outcome is not clear at the moment of adoption. We do not include any measure of risk aversion in our model, but other studies confirm that low cognitive skills are associated with impatience and higher risk aversion (Dohmen et al. 2007; Burks et al. 2009).

Overall, financial literacy may improve farmers' ability to cope with the disequilibrium effect caused by new technologies. They adjust better to change and are therefore more likely to adopt innovations like the GlobalGAP standard. Financial literacy is not exogenous in our model. Our results might be biased due to some unobserved characteristics that influence financial literacy and GlobalGAP adoption alike, such as intelligence, ambition and diligence. We do not control for this due to the lack of an adequate instrument. Lusardi and Mitchell (2014) summarize the results of research papers that use an instrumental variable approach to control for the endogeneity of financial literacy. In the studies they reviewed, the effect of financial literacy on economic behavior persists even when implementing an instrumental variable approach. But there may still be unobservable variables, such as motivation or intelligence, which bias the results. To overcome this bias, panel data or experimental approaches are needed to isolate the real effect of financial literacy on economic behavior.

7. Conclusions

The increasingly integrated global food system poses new challenges for smallholders. Whether small farmers benefit from the changes might depend heavily on their skills and capacity to adapt to change. It is especially important to comply with food safety and quality standards in order to participate in the high agricultural value chains. The

objective of this paper was to assess the role of financial literacy in standard adoption. Financial literacy has only recently gained attention in agricultural economic research and has not been studied yet in relation to process innovation adoption.

This study focuses on fresh pea production in the Guatemalan highlands. This smallholder-dominated sector has suffered a great deal from sanitary and phytosanitary violations and pesticide overuse. Nevertheless, compliance with food safety standards such as GlobalGAP is very low. In our study we show that, in addition to capital endowment and access factors, financial literacy is a significant factor in the standard adoption process. Farmers with a higher score on the financial literacy index are more likely to adopt GlobalGAP than those with lower scores on the test. The results confirm the assumption that not only access and endowment factors, but also skills like financial literacy play an important role in technology adoption. Whereas cognitive skills in the form of financial literacy matter in GlobalGAP adoption, formal school education is not significant in our setting.

Our results have important practical implications for the public and private actors. Integrating small farmers from developing and transition economies into the modern agrifood system is a concern for the public sector, development organizations and private companies, such as exporters. Huge efforts in the form of extension services, development projects and public subsidy programs are designed in order to help farmers. The adoption of new technologies is an integral part of rural development policies. The public sector may take a leading role in providing the infrastructure, functioning institutions and securing access, but this is not enough. We showed that farmers' ability to use resources and access are important in the adoption process. Hence, farmers' capacity building should be an integral part of rural development policies in Guatemala. Formal schooling may not equip farmers with the skills necessary to cope with new technologies. Informal learning, learning-by-doing and learning from others seem to be important in skill development. Education policy should foster business-related learning through formal education but also informal learning opportunities like group-based learning through farmer field schools or through the use of information technologies in extension services. It might also be helpful for farmers interested in food standard adoption to learn from farmers who are already certified. Platforms for these services could be capacity-building activities or farmer field days. In Guatemalan agriculture, private

actors, such as exporters, are taking the lead when it comes to the adoption of food safety and quality standards. The extension services and training they provide is typically centered on agronomic topics. As farmers are increasingly integrated in complex global value chains, they are transforming from being subsistence farmers to being entrepreneurial farmers. Our results show that exporters should also include more business-related capacity building into their extension repertoire if they seek sustainable conformance with international food standards.

We acknowledge that we have to interpret our results with care. We did not control for endogeneity in the form of an omitted variable problem as we lack a valid instrument. Factors like ambition, intelligence or openness might influence financial literacy and standard adoption alike. We are aware that our results might have limited external validity. Nevertheless our work is a first explorative step towards a better understanding of the role of cognitive skills like financial literacy in agricultural innovation adoption.

Small farmers in developing countries are faced with an ever more complex decision environment. Being equipped with the necessary skills to make proper decisions is vital. Better knowledge of financial matters helps farmers to improve their decision-making ability, their capacity to foresee and adapt to market trends and their resilience and entrepreneurial independence. We took an initial exploratory step towards a better understanding of the role of financial literacy in standard adoption. Further research should deepen the understanding of how financial literacy affects technology adoption. This could be done by considering different dimensions of financial literacy in the analysis or by stratifying the sample based on literacy groups. The effect of financial literacy may also depend on interactions with other variables. To improve the validity of the results, endogeneity problems should be addressed by such means as randomized control trials and other experimental approaches. Looking deeper into the sources of financial literacy - whether developed through formal education or through informal learning and experience - could help improve the design of training programs.

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9. Appendix

A1 Numeracy and financial literacy test

If there is a possibility of 10% of getting ill, how many persons out of 100 would get ill?

Five persons have bought the winning number in a lottery. The prize is 2,000 quetzals. How much will each winner receive?

Imagine you had 1,000 quetzals in a savings account. The annual interest rate is 2% (20 quetzals in the first year). After five years, how much will you have in the saving account if you do not touch the money?

- More than 1020 quetzals
- Exactly 1020 quetzals
- Less than 1020 quetzals

Imagine that your income will double next year. The prices of all the products that you consume will also double. With your income, how much will you be able to buy next year?

- More than this year
- The same as this year
- Less that this year

The bank has leant you 3,000 quetzals; the interest rate is 1% every month. If you pay 30 quetzals every month, when will you have paid back the loan?

- In less than five years
- In less than ten years
- Never

Imagine you get a loan of 1,000 quetzals from the bank. Which option is better for you?

- To pay 5% interest every month
- To pay 24% interest a year

A2 Principal Component analysis for financial literacy test

Table A-1 Principal components for financial literacy

Principal components/correlation
Number of obs.   =   277
Rotation: (unrotated = principal)
Rho   =   1.0000

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	4.10547	3.30873	0.6842	0.6842
Comp2	0.796745	0.373399	0.1328	0.8170
Comp3	0.423346	0.15087	0.0706	0.8876
Comp4	0.272477	0.0172805	0.0454	0.9330
Comp5	0.255196	0.108431	0.0425	0.9755
Comp6	0.146765	0.	0.0245	1.0000

Table A-2 Factor loadings for component 1

Principal components (eigenvectors)

Variable	Comp1
Probability skills	0.3610
Division skills	0.3033
Interest	0.4553
Inflation	0.4363
Credit repayment	0.4187
Interest2	0.4524

Table A-3 Kaiser-Meyer-Olkin measure of sampling adequacy

Variable	KMO
Probability skills	0.8972
Division skills	0.8668
Interest	0.8617
Inflation	0.9122
Credit repayment	0.9283
Interest2	0.8698
Overall	0.8888

Table A-4 Bartlett's test of sphericity

Chi-square	1163.503
Degrees of freedom	15
p-value	0.000

A3 Principal component analysis for asset index

Table A-5 Principal components for the asset index

Principal components/correlation

Number of obs.   =   277

Rotation: (unrotated = principal)

Rho   =   1.0000

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.84616	0.429529	0.1420	0.1420
Comp2	1.41664	0.139036	0.1090	0.2510
Comp3	1.2776	0.0526699	0.0983	0.3493
Comp4	1.22493	0.16598	0.0942	0.4435
Comp5	1.05895	0.0197427	0.0815	0.5249
Comp6	1.03921	0.140667	0.0799	0.6049
Comp7	0.89854	0.0263536	0.0691	0.6740
Comp8	0.872187	0.0525365	0.0671	0.7411
Comp9	0.81965	0.105628	0.0671	0.7411
Comp10	0.714022	0.015416	0.0549	0.8591
Comp11	0.698606	0.0892119	0.0537	0.9128
Comp12	0.609394	0.0852783	0.0469	0.9597
Comp13	0.524116		0.0403	1.0000

Table A-6 Factor loadings for component 1

Principal component 1 (eigen-vectors)

Variable	Comp1
Car	0.1752
Pickup	0.3797
Motorbike	0.1257
Bike	0.0525
Truck	0.3073
Knapsack sprayer	0.2996
Knapsack manual	0.1785
Irrigation	0.3449
Reservoir	0.3278
Storage silo	0.1088
TV	0.3500
Radio	0.2796
Mobile	0.3895

Table A-7 Bartlett's test and KMO

Bartlett's test of sphericity	
Chi-square	1163.503
Degrees of freedom	15
p-value	0.000
KMO	0.560

A4 Variables used in the adoption model

Table A-6 Variables, specification and expected effects of the variables used in the adoption model

Variable	Specification	Expected effect
Age	Age of household head in years	+
Gender	Dummy, 1 if male 0 if female	
Education	Education of household head in years of formal schooling	+
Members	Number of household members working on farm	+
Off-income	Household off-farm income per capita in quetzals	+
Ha owned in 2009	Total ha with formal property title in 2009	+
Land title	Dummy, 1 if farmer has any formal land title, 0 otherwise	+
Irrigation	Dummy, 1 if farmer is using irrigation on at least one plot, 0 otherwise	+
Remesas	Dummy, 1 if household is receiving remittances, 0 otherwise	+
BonoSeguro	Dummy, 1 if household is part of conditional cash transfer program	
Cell	Dummy, 1 if farmer is using cell phone, 0 otherwise	
BuyerFFV	Dummy, 1 if there is a buyer for fresh fruit and vegetables in the village, 0 otherwise	+
TarmacRoad	Dummy, 1 if the village is connected via tarmac road, 0 otherwise	+
Asset	Index of farm assets	+
LivestockNR	Number if Livestock owned	
Mother tongue	Dummy, 1 if mother tongue of the farmer is Spanish, 0 otherwise	+
Exporter before 2009	Dummy, 1 if farmer has worked with an exporter before 2009	+
FLX	Financial literacy index	+
Credit_formal	Dummy, 1 if farm-household has access to formal credit, 0 otherwise	+
Experience pea	Experience in pea production in years	+
Specialization	Share of land allocated to pea production in 2011/12 in %	+
T_costs	Transportation costs to the next market measured in dollars per kg	-

Financial literacy and food safety standards in Guatemala: The heterogeneous impact of GlobalGAP on farm income

1. Introduction

With the transformation of the global agri-food system, the role of organizational and process innovations in global agricultural value chains is gaining importance. The dominance of process related standards (public and private) that are applied in agricultural production and farm management is one characteristic of the ongoing dynamics.[13] There is a lot of discussion in development research and practice about the impact of the increasing standardization of agriculture on small farmers in developing countries. Two scenarios are discussed. First, it is argued that the increasing requirements on food quality and safety might challenge already marginalized producers in countries with weak quality infrastructure. Due to high compliance costs and missing capacities and skills, farmers might not be able to comply with the new requirements. This could lead to negative socioeconomic effects with consequences for rural poverty. The second scenario is more optimistic. It sees positive upgrading effects with benefits for farmers and the agricultural sector in general. The more stringent requirements could induce upgrading activities in the agricultural sector, helping farmers to increase productivity, decrease production costs, improve quality and safety and thus gain better access to international high-value chains and receive better prices and higher agricultural incomes.

Studies examining the economic impact of adopting food quality standards generally find that doing so has a positive effect (Asfaw et al. 2009; Holzapfel and Wollni 2014; Hansen and Trifković 2014b; Subervie and Vagneron 2013; Handschuch et al. 2013). This overall positive effect stems from special price arrangements, quality improvements, the use of contracts, tighter supplier-buyer relationships, and higher efficiency in farm input use. But even between certified farmers, the economic impact can vary with the institutional arrangements (Holzapfel and Wollni 2014), access to infrastructure (Subervie and Vagneron 2013) and/or farm size (Hansen and Trifković 2014). Capital

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[13] Standards like GlobalGAP address processes on the farm level, i.e. they require new pest management strategies, record keeping for traceability issues and specific training for the farmer and any farm employees. Process standards are an organizational innovation or technology that farmers choose to adopt as part of a farm investment decision. We use the terms innovation and technology in a broader sense that also embraces process standards. Process standards such as GlobalGAP are also part of the category of food safety and quality standards.

endowment, access to resources and information, and farmer's capacities seem to influence the heterogeneity in how standards impact the economic situation of small farmers.

Process standards pose new challenges to farmers' skills: They require new techniques not only on the production level (like integrated pest management systems or soil and water management) but also in the management of the farm (safety and occupational health, control of input usage, environmental and risk management, etc.) (FAO 2014). Apart from asset endowment and access, other skills are required to comply with process standards. We have shown in earlier research that GlobalGAP[14] adopters and non-adopters differ in their level of financial literacy and that this difference explains some of the differences in adoption behavior (Müller and Theuvsen, 2014): Farmers with a higher level of financial literacy are ceteris paribus more likely to adopt GlobalGAP. Whether the economic impact of GlobalGAP differs according to the financial skill level of farmers is a question that has not been addressed yet. Keeping in mind the importance of impact heterogeneity, we address two questions in our research: What is the impact of GlobalGAP adoption on farm income? How does the economic impact of GlobalGAP on farm income differ in relation to the financial literacy level of farmers?

We study the case of GlobalGAP among small pea producers in the Guatemalan highlands. The region is dominated by small-scale fresh vegetable production. Peas are only produced for export and are therefore subject to stringent food safety and quality standards on international markets. Small farmers in the region are very poor. The public sector and non-profit organizations are interested in lifting farmers out of poverty through improved and sustainable market integration. Against this background, it is of high interest to understand in greater detail the impact of GlobalGAP certification on small farmers' economic situation.

We use a cross-section sample of 276 pea farmers. The data was collected in 2012 using a stratified random sampling strategy. Using matching techniques we show that GlobalGAP has a robust positive impact on the revenue of pea producers. The impact on total revenue from agricultural production and total household income is less robust but still positive. By stratifying the sample in low and high financially skilled farmers we

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[14] The correct spelling is GLOBALG.A.P. For better readability we use the spelling GlobalGAP throughout the paper.

show that the impact of GlobalGAP on pea revenue is positive for financially skilled farmers, whereas there is no significant impact for farmers with low financial skills. Our research contributes to the ongoing debate about how food standards impact small farmers in developing countries. Considering the role of farmers' financial skills in the impact of innovations stresses the importance of capacity building for farmers.

The remainder of the paper is structured as follows: First, we review the relevant literature on innovation adoption and financial skills, which helped us to build our conceptual framework. Next, we provide information about the research context, data and sampling and about our variables of interest. Section four lays out our empirical methods. Section five describes our results. Section six discusses the results of the impact analysis of GlobalGAP on farm revenue and examines the heterogeneous impact of GlobalGAP on farm revenue considering financial literacy. The paper ends with our conclusions.

2. Literature review

Organizational innovations and their economic impact

With the on-going transformation of the global agri-food system, there has been a commensurate increase in research on the impact of organizational innovations, such as standards or contracts, on small farmers. The economic impact of private food quality and safety standards has gained special attention as they are becoming increasingly mandatory for accessing high-value chains.

Asfaw et al. (2009) show that adoption has a positive effect on net income for Kenyan fresh vegetable producers. The positive impact on net income also positively correlates to area under vegetable production and asset endowment. Holzapfel and Wollni (2014) study the net income effect of donor-supported GlobalGAP implementation. They find different impacts on farmers' income based on the management scheme used by the producer group and the size of the farm. There seems to be a significant income effect for producer-managed groups, whereas there is none for exporter-managed groups. Only for producers that pass a threshold of one hectare of farm size does GlobalGAP adoption seem to be profitable. By using quantile regressions to estimate the effect of food safety standards in pangasius production on the consumption expenditure of Vietnamese farmers, Hansen and Trifković (2014) identify a "middle class effect". Only on larger

farms do the standards have a positive and significant effect on expenditure. Smaller family farms do not benefit from the implementation. Subervie and Vagneron (2013) do not directly measure the income effects of GlobalGAP but use proxies for farm performance to assess the effect of certification on farmers in Madagascar. Using matching techniques, they find that GlobalGAP certification has a positive impact on the quantities sold and the prices received. The benefits are not homogeneously distributed among all certified farmers, however, but are concentrated among a small group of farmers that is able to transport the product themselves to the next marketing center. In the case of Chilean raspberry producers, Handschuch et al. (2013) find that, once farmers overcome the barrier of entry to certification, they benefit through positive effects on quality performance and farm net income. To control for possible selection bias through self-selection of the farmers into the standard scheme, they use a treatment effects model with an endogenous dummy variable.

Through their study on supermarkets and fresh vegetable farmers in Kenya, Rao and Qaim (2011) show that it is important to differentiate between groups when analyzing economic impacts since marketing channels are structurally different. The effect of variables such as off-farm income and vehicle ownership has different magnitudes among farmers depending on their use of traditional or modern marketing methods. Other variables have a significant effect on only one group; for example, land ownership only influences the income of traditional farmers. In contrast to some findings from the specific standard impact literature, Rao and Qaim (2011) find that small farmers benefit over-proportionally from participation and poor households benefit more than non-poor households. As small farmers are mainly subsistence farmers, the income gains through new marketing channels seem to be substantial. Delivering directly to the supermarket also offers more benefits for farmers as middlemen are avoided.

The literature discussed suggests that there is evidence of the positive impact of organizational changes in the agri-food system on farmers. Small farmers may benefit through special price agreements (premium price, fixed price or minimum price) as buyers have a high interest in locking in suppliers and securing guaranteed supplies. Often exporters have to make significant asset-specific investments in order to bring smallholder farmers to certification; this creates an interest in longer term relationships. Even if the farmers do not receive a higher gross price, they may receive higher net prices through re-

source-providing contracts or benefit from having lower marketing risks as adoption of a food safety standard leads to closer supplier-buyer relationships through formal or informal contract systems (Reardon et al. 2009). But it seems that these benefits are not homogeneously distributed among all farmers alike. The impact of organizational innovations might depend on resource endowment, access to resources and the institutional environment. This indicates the importance of adequately considering the heterogeneity of the groups with regard to, for instance, endowment and access when measuring the economic impacts of standards and other organizational innovations. Since successful adoption of innovations may depend not only on access to resources but also on farmers' knowledge and capabilities, taking into account farmers' skills could contribute to a better understanding of the heterogeneity in economic impacts of organizational innovations in food supply chains. But so far there is a lack of papers in the standards impact literature that argue from the perspective of farmers' skills.

Financial literacy and the impact of new technologies

With regard to the successful adoption of innovations, farmers' financial literacy is a crucial competence due to, for instance, the growing requirements with regard to documentation and other bookkeeping. Despite this crucial role, the literature on financial literacy and the economic impact of agricultural technologies in developing countries is scarce so far. In order to understand how financial literacy can influence the impact of agricultural innovations at the farm level, we look at the broader literature on the role of cognitive skills and education for economic well-being. Financial literacy can be seen as one component of cognitive skills acquired through formal and informal education, experience, family, peers and culture (van Rooij et al. 2011; Lusardi and Mitchell 2014)

The positive effect of education on agricultural outcomes is attributed to increases in productivity (Appleton and Balihuta 1996) and farm efficiency (Lockheed et al. 1980). But research also indicates that the positive effect of education depends on situational characteristics and that education might be more useful for specific farmers. Alene and Manyong (2007), for instance, find a heterogeneous effect of education and production technology: For cowpea producers in Nigeria, there is a positive and significant effect on productivity only when they produce with modern technologies. They explain the positive effect as a result of the improved use of inputs by better educated farmers to produce a given set of outputs (efficiency perspective).

Education is often measured as attainment in school (Appleton and Balihuta 1996; Jamison and Moock 1984). But this might be misleading and incomplete in explaining differences in economic outcomes (Hanushek and Woessmann 2008). Number of years of schooling does not imply quality and does not necessarily lead to the development of relevant job skills. Skills are formed by formal schooling and education, but also through informal learning like learning-by-doing or learning from others (Bandura 1971). Family and peers influence skills, as do culture and context in general (Jamison and Moock 1984; Jolliffe 1998). Considering skills in explaining economic outcomes therefore has more explanatory power and shifts the attention from pure attendance in school, schooling years or participation in extension activities to the skills attained.

For a better understanding of the effect of skills on economic outcomes, skills can be differentiated into cognitive and non-cognitive skills (Appleton and Balihuta 1996). Cognitive skills refer to directly measurable skills, such as mathematical skills, numeracy or financial literacy. Non-cognitive skills refer to attitudes and behaviors, such as openness, self-discipline or ambition. There is strong empirical evidence that cognitive skills have a positive effect on farm performance.

In the case of US dairy farmers, Jackson-Smith et al. (2004) find a link between the understanding of financial concepts and greater financial returns. Hanushek and Woessmann (2008) evaluate a number of studies and come to the conclusion that cognitive skills (rather than schooling attainment) are strongly related to individual earnings in developing countries. Jolliffe (1998) finds that, for a sample of Ghanaian farmers, average scores in English and mathematics have a positive and significant effect on total and off-farm income but not on farm income. But there is also empirical evidence that skills are highly relevant for successfully performing agricultural activities. In the case of wheat production in Nepal, Jamison and Moock (1984) find that numeracy has a positive and significant influence on productivity. Due to increasing knowledge requirements, education might play an even bigger role in modern agriculture than in traditional agriculture (Alene and Manyong 2007).

Conceptual framework

Considering the literature on the economic impact of standards and cognitive skills, we assume that the impact of GlobalGAP on farm performance is positive and heterogene-

ous among different levels of financial literacy. We propose that financially literate farmers might benefit more from the positive income effects of GlobalGAP adoption than those farmers with lower levels of financial literacy.

Referring to the theoretical arguments for the effect of skills and education on farm income outlined above, we derive several arguments to underpin our proposition. Financial literacy as a cognitive skill may help farmers to improve their farm management. Due to their skills, they may have more efficient financial and improved input management and may be more efficient in implementing extension advice. Overall financial literacy might also help them in continuous standards compliance and thus may contribute to secured sales. Working with a certain standard scheme often comes with formal or informal credit schemes that help farmers to pre-finance their production. Good financial skills improve credit management and may also influence the overall risk management of the farm. All these aspects may help farmers to improve farm performance through increased efficiency, higher productivity and secured high quality production. Financial literacy could also influence farm performance through non-cognitive effects. By learning about the positive effects on price and income when producing consistently according to a certain quality level, farmers might be more willing to change their production practice; for example, they might apply integrated approaches to pest management that are required for GlobalGAP certification. Financial literacy could also discipline farmers by making them acquainted with continuous labor efforts (Kieser 1998) and make individuals more open to new ideas and changes in working routines.

In short, cognitive and non-cognitive skills are important for adapting to a changing environment and new technological requirements (Alene and Manyong 2007). They help to allocate farm resources in an efficient manner and thus increase a farm's allocative and technical efficiency and improve the farmer's ability to acquire, decode and use information (Jamison and Moock 1984). Farmers with a higher level of financial literacy, therefore, might adjust more successfully, apply organizational and technical innovations more efficiently and hence benefit more from new technologies than less skilled farmers.

3. Research background

3.1 GlobalGAP and food safety in Guatemala

We focus on GlobalGAP as this is the most widespread standard system in the fresh fruit and vegetable trade affecting developing countries. GlobalGAP is a pre-farm gate and process-standard that requires the implementation of good agricultural practices and various quality and food safety measures. The private standard is non-mandatory in nature and was established in 1999 by several European retailers.[15] The standard has a quasi-mandatory character, as many retail chains invariably require compliance in their fresh fruit and vegetable assortment. GlobalGAP compliance is not signaled to the final consumers and there are no regulations about the price and the supporting mechanisms (FAO 2014). GlobalGAP is sometimes criticized for not being smallholder friendly as investments in production changes and certification are high (Willems et al. 2005). To address this concern there are two certification options: Option 1 is for individual certification; option 2 is for group certification. With option 2, certification producer groups run a joint quality management system and can share some investments (like a collection center and auditing costs). In the recertification process, a random fraction of the group is audited, which significantly reduces the recertification costs. Within the producer group, whether to opt for certification is an individual decision. GlobalGAP obliges the farmer to have a contract with the buyer and to market certified products exclusively through the group (GLOBALG.A.P. 2013).

Guatemala has a very low institutional capacity in food safety and quality, and corresponding problems have been widespread (Julian et al. 2000). This challenges public and private compliance efforts and increases compliance costs (Henson 2007). Pea exports in particular have suffered from high detention rates due to microbiological contamination and pesticide residues (Henson 2007). In an export-oriented sector that is dominated by capital-poor smallholders, non-conformance with international food quality and safety regulations has considerable economic effects. Fresh peas are produced mainly for export to the United States and Europe; a negligible fraction of the crop stays within the country.

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[15] Detailed information about the standard can be found at http://www.Globalgap.org.

To improve the competitive position of pea production, public and private actors work on improving the food quality and safety system in Guatemala. For several years now, the non-traditional export sector has been using GlobalGAP increasingly as an instrument to reach conformance with international norms. It remains the most important food safety and quality standard for Guatemala. In August 2012 there were 1,233 certified farmers in Guatemala, over 800 of them fresh pea producers (GLOBALG.A.P. 2013). This reflects the importance of the product among fresh vegetable exports as well as the small-scale structure of the sector and the vulnerability of pea exports to export detentions. Even though GlobalGAP certification is increasingly demanded, exporters still source non-certified product for export. The certification of small farmers has not developed quickly enough that the demand for fresh peas can be met with certified products.

In the case of small pea farmers in Guatemala, exporters bear the major part of the certification costs. Apart from costs for audits, training and extension services, significant on-farm investments have to be undertaken. It is very difficult to quantify the recurrent and non-recurrent costs that farmers face due to certification. The impression from the field is that costs come mainly in the form of opportunity costs of attending trainings and extension service activities. Exporters seem to modify their price schemes in order to recover part of their investment, like deducting a small fraction from the product price for refinancing the investments in GlobalGAP certification. But again, there is no systematic and valid quantitative information on the costs of GlobalGAP certification since neither farmers nor farmer groups have much knowledge about the costs of certification and the way exporters deal with them.

3.2 Data and Sampling

In this study, we use a sample of 276 fresh pea farmers who were surveyed in the departments of Chimaltenango and Sacatepéquez in the Guatemalan highlands between August and October 2012. Around 90% of the national pea production is concentrated in these two departments. Both departments are adjacent to the capital city and the metropolitan area and dispose over a good road infrastructure. This favors the production of export crops due to better access to modern infrastructure and lower transportation and transaction costs.

We gathered data on the socio-demographic and socio-economic situation of the farm households as well as on agricultural production and marketing, certification and financial literacy. The data refers to all agricultural and non-agricultural activities that happened between August 2011 and July 2012. The financial literacy section is based on widely used survey questions (OECD INFE 2011; Atkinson and Messy 2012). Six multiple choice questions cover general knowledge of numeracy (percentage calculation and division) and more specific financial skills like inflation and interest calculation. We presented the questions as a small quiz rather than a test to the farmers to make them feel more comfortable. If a farmer was not able to answer the two general numeracy questions, we did not perform the financial literacy test. The test questions were then coded as "does not know".

We contacted farmer groups through the help of two exporters and one non-governmental organization. We interviewed farmers from 16 farmer groups and used a stratified random sampling strategy. Our treatment group consists of 152 certified farmers who are members of a farmer group. Our first control group consists of 64 non-certified farmers who are also members of the same farmer groups. Within the farmer group, we randomly selected the certified and non-certified interviewees from the member list. GlobalGAP certification within the farmer group is still an individual decision. The second control group consists of 60 non-certified and non-organized farmers. This group sells to intermediaries or the spot market, where no standardized quality selection of the product takes place. We decided to include this group to be able to control for group level effects. The second control group was selected using the random walk method. Additionally, we used secondary data on transportation costs provided by the International Food Policy Research Institute.

3.3 Measurement of the outcome variables

Our treatment variable GlobalGAP takes the value 1 if a farmer has ever been certified by GlobalGAP We happen to have producers in our sample that had been certified for some time but did not manage recertification. We treat them as certified producers as we assume that they are more similar to certified producers in terms of endowment, access and marketing situation.

The outcome variables used in our model are total household income, revenue from pea production and revenue from total agricultural production. We use three different outcome variables as it might be that GlobalGAP adoption adversely affects revenue from agricultural production and total household income. GlobalGAP certification might increase revenue from pea production and thus foster reallocation of labor and capital towards pea production (specialization), which may go to the cost of non-pea and off-farm earnings. Therefore, we consider it important to look at the different income components of the household in order to better understand the impact of the certification standard.

Revenue from pea production is measured as the total revenue generated by the commercialization of the pea production in the recall period. Total household income is the sum of revenue from agriculture and off-farm activities. We do not consider income from rents, remittances or social transfer programs. We chose revenue from pea production as our cost data do not contain enough information to calculate the net income from pea production. Farmers often receive inputs to pre-finance their harvest. We do not know whether the buyer considers this in the price or not. Nevertheless, the impact on revenue indicates a tendency about how GlobalGAP and financial literacy influence the economic situation of farmers. Mendola (2007) also uses gross agricultural income as a proxy for household economic well-being and argues that the differences in production costs depend on farmers' production capacity, which is already taken into account when assessing the impact of an innovation on household income.

4. Methods

4.1 Matching

The counterfactual problem

In economic impact evaluation, researchers have to deal with a causal inference problem (Gertler et al. 2011). Establishing a causal relationship is not straightforward when assessing the effect of innovation adoption on an outcome of interest. An individual's income might have increased even without the innovation. An ideal impact evaluation rules out all the confounding factors to establish the unbiased and true relationship be-

tween treatment and outcome.[16] In the case of our research question - *What is the impact of GlobalGAP on farm income* - the basic impact evaluation equation is this:

$$(1) \qquad \alpha = (Y \,|GG = 1) - (Y \,|GG = 0),$$

where α is the individual treatment effect of GlobalGAP certification GG on the outcome Y, measured as the difference between the outcome for the <u>same</u> unit of observation (in our case farmers) with and without certification. The impact evaluation ideal confronts us with the counterfactual problem: In our state of the world, it is simply not possible to observe one individual's outcome both with and without treatment.

In order to deal with this counterfactual problem, we have to establish a valid non-treated control group that is as similar as possible to the treatment group. This can be done by evaluating pre- and post-treatment characteristics or by comparing treated and untreated subjects (Gertler et al. 2011).

Given the cross-sectional data available to us, we measured the following average treatment effect on the individuals that actually received the treatment (ATT):

$$(2) \qquad ATT: E \left(Y_i \mid GG = 1 \right) = E(Y_{i1}|GG = 1) - E \left(Y_{i0}|GG = 0 \right),$$

where $(Y_{i1}|GG = 1)$ is the outcome for subjects who have adopted GlobalGAP and $E \left(Y_{i0}|GG = 0 \right)$ is the outcome for those who have not adopted GlobalGAP.

However, comparing treated and untreated subjects still might not reveal the real treatment effect of innovation adoption. We have to take into account selection on observable and unobservable characteristics of the subjects.

Selection on observable characteristics means that outcome and treatment are independently conditional on the covariates X. Characteristics X that are observed by the researcher determine whether a subject receives the treatment or not (e.g. farm assets) and differs between the two groups. We can control for this bias by including the necessary covariates in our model.

Bias arising from selection on unobservable characteristics is more difficult to control for, as those are characteristics not measured by the researcher. It means that the out-

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[16] In the impact assessment literature, the term treatment is commonly used. The treatment in our case is GlobalGAP certification.

come is independent of the treatment conditional on the covariates X and characteristics "hidden" in the error term. Some unobserved characteristics, such as ambition or laziness, may influence an individual's participation in a treatment and the outcome alike. Hidden bias is likely to influence the estimated treatment effect.

$$(3) \qquad ATT: E\ (Y_i \mid GG = 1) =$$

$$E(Y_{i1}|GG = 1) - E\ (Y_{i0}|GG = 0)\ +\ E\ (Y_{0i}|GG = 1) - E\ (Y_{0i}|GG = 0),$$

where $E(Y_{i1}|GG = 1) - E\ (Y_{i0}|GG = 0)$ is the ATT we want to measure and $E\ (Y_{0i}|GG = 1) - E\ (Y_{0i}|GG = 0)$ is the selection bias arising from unobserved variables. Without controlling for selection on unobservable characteristics, we would measure the biased treatment effect as displayed in equation (4) (Caliendo and Kopeinig 2005). Only if the second term of equation (3) equals zero can we measure the real ATT. One solution to this problem would be an experimental research design with the random assignment of the treatment (randomized control trials) and data on pre-treatment characteristics of the subjects. We do not have this data, so we have to find a way to deal with the selection problem.

Matching techniques

One common approach to controlling for selection on observables in the absence of experimental data without random assignment of the treatment is the use of matching techniques. Matching techniques create a counterfactual group for observational data by matching each treated subject with one (or more) untreated subjects with similar observed characteristics. As it is almost impossible to find a match that is equal in all covariates, it is more efficient to match a single-index variable - the *propensity score* of being treated (Becker and Ichino 2002).

Propensity Score Matching (PSM) on observable characteristics helps to reduce the bias caused by unobservable factors but does not eliminate it (Becker and Ichino 2002). The assumption behind this is that, by matching individuals on their observable characteristics, we are also doing so—to a certain degree—for the unobservable characteristics. Bias can only be completely eliminated if the exposure to treatment is completely random among the individuals who have the same propensity score.

The propensity score is the conditional probability of receiving the treatment given pre-treatment characteristics (Becker and Caliendo 2007):

$$(4) \quad p\,(X) = \Pr(GG = 1\,|X\,) = E\,(GG\,|\,X).$$

GG = {0, 1} is an indicator of exposure to the treatment (in our case GlobalGAP certification) and X is a multidimensional vector of pretreatment characteristics.

In order to identify the true ATT with PSM, two assumptions have to be met: the conditional independence assumption (CIA) and the overlap assumption.

The CIA requires that selection into treatment be based only on observable characteristics. Apart from the characteristics that are observed by the researcher and that influence treatment and outcome alike, there should be no confounding unobservable characteristics that influence selection into treatment (Caliendo and Kopeinig 2005). With non-experimental data (where the assignment to treatment is endogenous), we cannot test directly whether the CIA has been met. If the assumption has not been met, we would have unobserved variables that simultaneously affect selection into treatment and the outcome, leading to biased estimates. PSM is not robust to this hidden bias (Becker and Caliendo 2007).

Several measures can be undertaken in order to address this problem (Abebaw and Haile 2013): Conditioning on several covariates in the propensity score model to minimize omitted variable bias, implementing matching in the region of common support and calculating Rosenbaum bounds. Rosenbaum bounds provide evidence of the degree to which any significant result is dependent on this assumption. The bounds estimate the degree to which an unmeasured variable must influence the selection process in order to undermine the results of the matching analysis (Caliendo and Kopeinig 2005). If the results are sensitive, one has to rethink the identification strategy. This approach uses the odds ratio of participation in a treatment between two matched individuals to evaluate whether the odds differ due to hidden bias (Rusike et al. 2014).

The overlap assumption (also known as the balancing property or common support condition) requires that subjects with the same X values in the covariates have a positive probability of being both participant and non-participant (Caliendo and Kopeinig 2005). Observations with the same propensity score must have the same distribution of observable (and unobservable) characteristics independent of their actual treatment status.

To test whether the overlap assumption holds true, the distribution of the propensity scores can be plotted by treatment and by control group. Another method is to calculate the normalized differences between the treatment and the control group (Cunguara and Darnhofer 2011).

If the propensity score p (X) is known and the assumptions are met, then the PSM estimator for the ATT is as follows (Caliendo and Kopeinig 2005):

(5) $\quad \tau \frac{PSM}{ATT} = E_{P(x)|GG=1} \{E[Y(1)|GG = 1, P(X)] - E[Y(0)|GG = 0, p(X)]\}.$

The PSM estimator is the mean difference in outcomes under the condition of common support, weighted by the propensity score distribution of the subjects in the sample (Caliendo and Kopeinig 2005).

Matching estimator

According to Caliendo and Kopeinig (2005) a good matching estimator does not eliminate too much of the original observations while at the same time it yields statistically equal covariate means for the observations in the treatment and control groups. In practice, different matching algorithms are used to test the robustness of the results. We employ three different matching estimators.

With the nearest neighbor matching (NNM) estimator, every treated unit is matched with a control unit. For each GlobalGAP adopter, the closest observation with similar observable characteristics is chosen from the non-adopters and compared. The effect of adoption on our variable of interest is computed as the average difference in income between each pair of matched observations (Mendola 2007). The disadvantage of this estimator is that, since the nearest neighbor might still have a very different propensity score, some matches can be very poor. NNM can be applied either with or without replacement (with replacement: one control unit is matched with several treated units).

With the radius matching (RM) estimator, each treated unit is matched with all the comparison observations that fall in a predefined neighborhood (caliper) (Caliendo and Kopeinig 2005). The advantage of RM lies in the use of additional observations if good matches are not available. RM allows the use of more information to construct the counterfactual by oversampling. This reduces the variance and avoids the bias caused by bad matches (Caliendo and Kopeinig 2005).

With kernel-based matching (KBM), the counterfactual is constructed using the weighted average of all households in the non-treated observations. KBM is a non-parametric estimator and more flexible than the NNM estimator (Mendola 2007). The advantage of KBM is that it uses more information, resulting in lower variance; however, bias might be increased since bad matches are also used to create the counterfactual (Caliendo and Kopeinig 2005).

The quality of any matching estimator is improved by imposing the common support restriction. When choosing a matching estimator, the trade-off between bias and variance has to be evaluated, especially in small samples (Caliendo and Kopeinig 2005). We employ the three matching estimators discussed in this chapter.

4.2 Principal Component Analysis

Principal component analysis (PCA) is a multivariate statistical technique to reduce a number of variables that describe the same latent variable to smaller dimensions. From an initial set of n correlated variables, PCA creates uncorrelated components that account for most of the variance in the data. Each component is a linearly weighted combination of the initial variables. The number of components extracted equals the same number as the initial set of variables, whereas the first component accounts for most of the variance in the data (Kolenikov and Angeles 2004). For a set of variables X_1 to X_n the principal components are

$$(6) \quad PC_1 = a_{11}X_1 + a_{12}X_2 + \cdots + a_{1n}X_n$$

$$\cdots$$

$$(7) \quad PC_m = a_{m1}X_1 + a_{m2}X_2 + \cdots + a_{mn}X_n \,,$$

where a_{mn} represents the weight for the mth component and the nth variable (Vyas and Kumaranayake 2006). The eigenvector of the correlation matrix is the weights of the principal components. The eigenvalue of the eigenvector is the amount of variance that is explained by the component (Vyas and Kumaranayake 2006; van Rooij et al. 2011). The first principal component always explains the largest amount of the underlying information of the variables used and is a linear index of all the variables used. The following components are not correlated with the first component and explain additional variance but a smaller part of the variation in the data.

We used unrotated PCA to construct a financial literacy index and a farm asset index. Using an index is a common approach in financial literacy research (van Rooij et al. 2011; Behrmann et al. 2010) and for wealth indices (Vyas and Kumaranayake 2006). The advantage over just summing up the number of correct answers in the financial literacy test or the number of assets is that PCA assigns weights to the variables according to their importance in contributing to the whole variation in the data - meaning its contribution in explaining the underlying latent phenomenon, which in our case is financial literacy or farm wealth (Langyintuo and Mungoma 2008).

For financial literacy, the first extracted component accounts for almost 70% of the variation in the data (table A-1 in the appendix). The factor loadings for the first component all have the same sign and are almost equal in magnitude (table A-2, appendix). We estimated the Kaiser-Meyer-Olkin (KMO) criterion of sampling adequacy to check whether the data used is suitable for PCA (see table A-3 in the appendix). The overall KMO score is higher than 0.8, which is considered a very good value. Bartlett's test of sphericity tests whether the correlations between the variables used are significant. The test indicates that we can reject the null hypothesis of zero correlations between the variables (see table A-4 in the appendix). We used the first component to construct the financial literacy index.

We performed the same procedure with 13 variables that are associated with farm assets. According to the KMO results, we can perform factor analysis, albeit with 0.56 it is lower than in the financial literacy index. Bartlett's test indicates that the data correlates sufficiently to perform PCA (see tables A-5 to A-7 in the appendix). Our farm asset index is proxy for the asset endowment of the farm. We do not have enough information in our dataset to create a wealth index.

5. Descriptive results

5.1 Descriptive statistics

In table 1 we display the descriptive statistics for the variables we are using in the propensity score model. For a detailed explanation of the variables used in table 1, see table A-8 in the appendix. We present the means for the entire sample and for the groups of certified and non-certified farmers. A t-test is used to reveal systematic differences in

the mean between certified and non-certified groups.

Table 1 Sample characteristics

	Whole sample	sd	Certified	sd	Non-certified	sd	Differ-ences[a]
Socioeconomic characteristics							
Age	44.366	12.502	45.118	12.433	43.444	12.574	-1.67
Gender	0.953	0.212	0.941	0.238	0.968	0.177	0.03
Education	4.648	2.83	4.691	2.852	4.597	2.814	-0.09
MembersOnFarm	3.728	2.045	3.770	2.114	3.677	1.965	-0.09
Mother tongue	0.062	0.241	0.059	0.237	0.065	0.247	0.01
Conditional cash transfer	0.199	0.400	0.191	0.394	0.210	0.409	0.02
Formal credit access	0.344	0.476	0.355	0.48	0.331	0.472	-0.02
Farm characteristics							
Ha owned before 2009	0.805	1.745	1.005	2.076	0.560	1.187	-0.44**
Land title	0.743	0.438	0.783	0.414	0.694	0.463	-0.09*
Irrigation	0.199	0.400	0.224	0.418	0.169	0.376	-0.05
BuyerFFV	0.857	0.349	0.841	0.366	0.877	0.327	0.04
LocalMarket	0.385	0.485	0.391	0.039	0.377	0.043	-.014
FarmX	-0.021	1.335	0.195	1.463	-0.286	1.109	-0.48***
Livestock_NR	0.909	0.793	1.013	0.797	0.782	0.771	-0.23**
Exporter before 2009	0.304	0.461	0.428	0.496	0.153	0.362	-0.27***
Experience pea production	11.619	7.922	11.187	7.476	12.148	8.436	0.96
Specialization	37.371	18.215	37.589	16.834	37.104	19.843	-0.48
T_costs	0.005	0.003	0.004	0.003	0.005	0.003	0.00*
Financial abilities							
FLX	0.011	2.021	0.391	1.862	-0.455	2.117	-0.85***
Observations	276		152		124		

[a] Differences in mean between certified and non-certified farmers; significance at * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Certified and non-certified farmers do not differ in their socioeconomic characteristics such as age, education, available farm labor force and participation in a conditional cash transfer program. There are statistically significant differences between the two groups in land holdings patterns (ha owned before 2009 and land title), asset endowment (farm assets and number of livestock owned), experience with an exporter (exporter before 2009), access indicator (transportation costs) and financial literacy. Certified farmers are better endowed with land and assets, have more experience with exporters, have better access to markets and perform better in financial literacy.

Commercialization

As we want to assess the economic impact of GlobalGAP adoption, we decided to first acquire a descriptive overview of aspects of commercialization in the sample (see table 2). This will help us to understand under which conditions the farmers market their products and how this might influence their economic situation. We asked the farmers to report the average price they received for peas from their buyers during the reporting time as well as the lowest and highest prices. In general, certified farmers receive a higher average price than non-certified farmers. The lowest price received is significantly lower for non-certified farmers than for certified farmers. Interestingly, there is no statistically significant difference between the two groups when it comes to the highest price received. According to the price information, it seems that certified farmers experience fewer "price peaks" than non-certified farmers and receive more for their product on average. GlobalGAP certification does not foresee a price premium for compliance. To make certification more attractive for the farmers (and to avoid side-selling), exporters offer certain price schemes. In our sample, 40% of the certified farmers market their product under a fixed price scheme which represents a significant difference to non-certified farmers. Fixed price schemes are not necessarily attached to certification schemes. Even non-certified farmers supplying exporters engage in fixed price schemes. Of course, fixed price schemes are not always good for the farmer. If the market price is higher than the fixed price, there is room for arbitrage, and the farmer could have earned more with the market price. This creates incentives for side-selling. To avoid this, exporters often rely on a minimum price scheme, that is, they agree upon a minimum price they always pay. If the market price is higher than the minimum price, they pay the market price. We do not have information on minimum price schemes in our sample.

Non-certified farmers have to wait significantly fewer days until they get paid than do certified farmers. Farmers told us that the long waiting period for payment is one disadvantage for them when it comes to supplying an exporter under a certification scheme. Farmers in our sample have very few sources of cash income. Especially during harvest, when they have to finance labor and equipment, disposing over cash is critical. Qualitative evidence suggests that the long payment periods are also one reason for side-selling to the spot market, which persists even among certified farmers.

Table 2 Commercialization

	Whole sample	sd	Cer- tified	sd	Non- Certified	sd	Differences
Average price GTQ[a] / Quintal[b]	268.24	90.38	289	83.47	240.48	92.35	-48.52[***]
Lowest price GTQ / Quin- tal[b]	210.01	114.67	235.41	105.69	178.06	117.89	-57.35[***]
Highest price GTQ[a] / Quin- tal[b]	335.93	132.16	340.60	110.97	330.23	155.75	-10.37
FixPrice (1 = Fix price)	0.36	0.48	0.40	0.49	0.31	0.46	-0.09[*]
Days until payment received	12.64	8.72	13.88	9.66	10.94	6.91	-2.94[***]
Delivery per sea- son/Quintal[b]	61.712	102.36	68.25	120.71	49.16	53.69	-19.09[*]
Observations	317		180		136		

Significance level at [*] $p < 0.10$, [**] $p < 0.05$, [***] $p < 0.01$
a GTQ= Guatemalan quetzal, for the time period July 2011 to August 2012 1 GTQ equaled on average 0.10 Euros[17]
b Quintal is a volume metric used in Guatemala; one quintal equals about 46 kg[18]

Both groups differ significantly in terms of volume supplied to buyers. Certified farmers deliver more on average. Above, we showed that certified and non-certified farmers allocate on average the same share of land to pea production (around one third of their land). The higher commercialized volume of certified farmers might be explained through higher yield or through better marketing opportunities (lower rejection rate, always able to find a buyer) enjoyed by certified farmers.

Buyers

Almost 60% of the buyer-supplier relationships in the sample are with an exporter (see table 3).[19] Looking at certified and non-certified farmers gives us a more detailed pic- ture. For certified farmers, more than 70% of trade relationships are with an exporter;

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[17] http://www.oanda.com/lang/de/currency/historical-rates/, checked 20.10.2014.

18 http://sizes.com/units/quintal.htm, checked 20.10.2014.

[19] On average, every farmer supplies to more than one buyer, so we have more observations on supply relationships than we have individual farmers.

for non-certified farmers, relationships with exporters constitute 40% of their supply relationships. Half of non-certified farmers' trade relationships are with intermediaries; in comparison, for farmers participating in the GlobalGAP standard, 15% of trade relationships are with intermediaries. We ran a chi^2 test of independence to see whether buyer and certification status are statistically related. The result suggests that certification status and buyer are indeed statistically related. This result is not surprising: Certification only makes sense when the product is commercialized through an exporter. More surprising is that a fraction of the certified farmers still sell to intermediaries. This might indicate side-selling. In both groups there are farmers who sell their product to a cooperative. In these cases, the cooperative can be seen as an intermediary that delivers the product collectively to the exporter.

Table 3 Buyer

Buyer	Whole Sample No.	%	Never certified %	Ever certified %
Intermediary	96	30.3	50	15.6
Cooperative	29	9.1	8.1	10
Wholesale market	4	1.3	1.5	1.1
Exporter	188	59.3	40.4	73.3
Total	316	100	100	100

Pearson $chi^2(3) = 44.8043$ Pr $= 0.000$

Over 50 % of the buyer-supplier relationships in the sample are regulated through a formal, written contract (see table 4). In almost 20% of the cases, there is an oral agreement between buyer and farmer, and in 26% of the cases there are spot market relationships (meaning no written or oral agreement). Almost 70% of trade relationships of certified farmers take place under a written contract compared to 33% of non-certified supplier-buyer relationships. On the other hand, almost half of non-certified trading happens on a spot-market basis.

Table 4 Contractual arrangements

Type of contract	Total	Total	Non-certified	Certified
	No.	%	%	%
No agreement	81	26.6	44.7	12.8
Oral agreement	59	19.4	22	17.4
Written agreement	164	53.9	33.3	69.8
Total	304	100	100	100

Pearson chi^2(2) = 47.7004 Pr = 0.000

GlobalGAP requires a contract between the farmer and the buyer. Contracts are seen as an important instrument for improving farmers' planning security and economic situation. In the case of pea producers in Guatemala, contracts with exporters come mainly in the form of a resource-providing contract and define specific components of the trading relationship, like price, volume, quality, input and extension service. Qualitative evidence suggests that farmers view contractual relationships with a preferred buyer with mixed feelings: They are aware of the advantages mentioned but also stress the disadvantage of being dependent on one buyer (buyer lock-in), who controls all the market and price information they need.

Farm income

Our outcome variables of interest are the revenues farmers receive from pea production, total agricultural income and total household income. As our income data is not normally distributed but highly right skewed, we took the natural logarithm of the income variables for our analysis. Taking the logarithm of income smoothes the income distribution and makes it less sensitive to outliers. Certified and non-certified farmers differ significantly in economic terms. Certified farmers have on average higher revenue from pea production, total agricultural production and total household income (see table 5). If we look at the absolute values of income in table 6, income from pea production is - on average - the main contribution to total household income for both certified and non-certified farmers. This underlines the importance of pea production for the small farmers in our study region. We do not see any significant differences in mean for the untransformed income variables. This stems from the distribution of the income variables for the two groups. The variables have a much higher variance for certified farmers than for non-certified farmers.

Table 5 Descriptive statistics for log transformed outcome variables

	Whole sample	sd	Certified	sd	Non-certified	sd	Diff-erences
Total HH in-come (log)	9.962	0.911	10.009	1.211	9.734	1.266	-0.28*
Total agricul-tural revenue (log)	9.473	0.994	9.622	0.949	9.294	1.026	-0.33***
Total pea rev-enue (log)	9.089	1.086	9.290	1.051	8.843	1.088	-0.45***
Observations	276		152		124		

Significance level at * p < 0.10, ** p < 0.05, *** p < 0.01

Table 6 Descriptive statistics for outcome variables

	Whole sample	sd	Certified	sd	Non-certified	sd	Diff-erences
Total HH income	32360.4	45724.1	35798.9	51726.6	27951.2	36860.8	-7847.7
Total agri-cultural revenue	22206.1	41538.7	25055.1	47248.4	18713.6	33087.9	-6341.5
Pea reve-nue	16990.2	38365.1	19743.1	43006.7	13704.4	31615.6	-6038.7
Obser-vations	276		152		124		

Significance level at * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.2 Descriptive statistics for financial literacy groups

As we are interested in the heterogeneous impact of GlobalGAP with respect to the financial literacy level, we split our sample into high and low financially literate farmers.[20] We see that, regardless of their certification status, farmers with a higher level of

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[20] The cut-off point is the median score in the financial literacy index. Farmers with a score below the median are classified as having low financial literacy; farmers with a score above the median are classified as having high financial literacy. Considering just two categories is very broad and might result in incomplete proxies for the different levels of financial literacy. However, considering more categories would result in very small subsamples, and matching estimators perform better with larger samples (Caliendo and Kopeinig 2005). It is more difficult to detect a treatment effect as standard errors increase.

financial literacy are on average younger and better educated. They also have better access to buyers in their village, which indicates that they benefit from better marketing conditions. Furthermore, farmers with a higher level of financial literacy are on average better endowed with farm assets. The same pattern holds true if we look only at certified farmers with high and low levels of financial literacy (see table 7).

Table 7 Sample characteristics for financial literacy groups (whole sample)

	Whole sample			Certified farmers		
	High FL	Low FL	Differences	High FL	Low FL	Differences
Socioeconomic characteristics						
Age	42.900	45.671	2.77*	43.571	47.029	3.46*
Gender	0.954	0.952	-0.00	0.964	0.912	-0.05
Education	5.492	3.897	-1.60***	5.452	3.750	-1.70***
MembersOnFarm	3.777	3.685	-0.09	4.012	3.471	-0.54
Conditional cash transfer	0.192	0.205	0.01	0.214	0.162	-0.05
Mother tongue	0.069	0.055	-0.01	0.071	0.044	-0.03
Formal credit access	0.300	0.384	0.08	0.298	0.426	0.13
Farm Characteristics						
Ha owned before 2009	0.910	0.711	-0.20	1.185	0.782	-0.40
Land title	0.777	0.712	-0.06	0.810	0.750	-0.06
Irrigation	0.223	0.178	-0.04	0.250	0.191	-0.06
BuyerFFV	0.931	0.795	-0.14***	0.893	0.779	-0.11*
LocalMarket	0.411	0.361	-0.05	0.433	0.338	-0.09
FarmX	0.182	-0.202	-0.38**	0.401	-0.060	-0.46*
Livestock_NR	0.946	0.877	-0.07	1.024	1.000	-0.02
Exporter before 2009	0.346	0.267	-0.08	0.452	0.397	-0.06
Experience pea production	11.724	11.525	-0.20	11.761	10.478	-1.28
Specialization	39.215	35.728	-3.49	39.203	35.595	-3.61
T_costs	0.005	0.005	0.00	0.004	0.004	-0.00
Observations	130	146		84	68	

Significance level at * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Looking at marketing patterns in respect to financial literacy groups, we see in table 8 that farmers with better financial skills have more GlobalGAP certificates than those with poorer financial skills; they receive on average a significantly better average price and a significantly higher lowest price. Significantly more highly financially literate farmers have a contract and deliver more to the buyer. These differences disappear when we look only at certified farmers: The only difference between high and low fi-

nancial literacy among certified farmers is in the average highest price they receive. Certified farmers with a higher financial literacy seem to receive higher prices for their product.

Table 8 Commercialization for financial literacy groups

	Whole sample			Certified farmers		
	High FL	Low FL	Differences	High FL	Low FL	Differences
GlobalGAP	0.646	0.466	-0.18***			
Average price GTQ / Quintal[a]	295.928	246.169	-49.76***	296.905	294.721	-2.18
Lowest price GTQ / Quintal[a]	245.267	182.966	-62.30***	243.467	247.517	4.05
Highest price GTQ / Quintal[a]	338.957	331.849	-7.11	351.429	323.468	-27.96[*]
Fix Price (1= Fix price)[a]	0.395	0.331	-0.06	0.393	0.397	0.00
Contract (1 = Contract)	0.875	0.565	-0.31***	1.583	1.545	-0.04
Delivery per season (Quintales)[b]	79.786	53.637	-26.15**	84.161	57.397	-26.76
Rejection rate (average)	12.854	12.595	-0.259	12.849	12.862	0.01
Observations	130	146		84	68	

Significance level at [*] $p < 0.10$, [**] $p < 0.05$, [***] $p < 0.01$

a Only for most important buyer; GTQ= Guatemalan quetzal, for the time period July 2011 to August 2012 1 GTQ equaled on average 0.10 Euros.[21] Quintal is a volume metric used in Guatemala; one quintal equals about 46 kg.[22]

6. Propensity Score Matching Results

6.1 The impact of GlobalGAP on farm income

Estimation of the Propensity Scores

The propensity scores of GlobalGAP adoption are estimated with a probit model.[23] Socioeconomic factors, such as age, education and members working on farm, do not influence the propensity to adopt GlobalGAP. Moreover, some farm characteristics play no role these include hectares owned, land title and irrigation system. Whether the

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[21] http://www.oanda.com/lang/de/currency/historical-rates/, accessed 20.10.2014

22 http://sizes.com/units/quintal.htm, accessed 20.10.2014

[23] For an explanation for the variables used in the model see table A-8 in the appendix.

farmers have farm assets and experience working with an exporter before 2009, influences positively GlobalGAP adoption. Conversely, experience in pea production and transportation costs negatively influence its adoption. Financial literacy positively influences the propensity to adopt. The results are displayed in table 9. For a description of the variables used in the model see table A-8 in the appendix.

Table 9 Estimated propensity scores of GlobalGAP adoption

Propensity of certification	Coefficient	Standard error
Age	-0.0348	(0.044)
Age2	0.001	(0.001)
Education	0.0518	(0.081)
Education2	-0.006	(0.006)
MembersOnFarm	0.026	(0.043)
Ha owned before 2009	0.05	(0.055)
Land title	0.156	(0.205)
Irrigation	-0.027	(0.244)
BuyerFFV	-0.264	(0.246)
FarmX	0.179**	(0.071)
Livestock_NR	0.096	(0.108)
Mother tongue	-0.234	(0.409)
Exporter before 2009	0.815***	(0.192)
Formal credit access	0.249	(0.172)
Experience pea production	-0.024**	(0.012)
Specialization	0.004	(0.005)
T_costs	-48.71**	(23.90)
FLX	0.128***	(0.044)
Constant	0.492	(1.012)
Observations	276	

Robust standard errors in parentheses, significance level at $^*p < 0.10,$ $^{**}p < 0.05,$ $^{***}p < 0.01$

Common support

To test whether the overlap assumption is met, we plot the distribution of the propensity scores of GlobalGAP adoption for GlobalGAP adopters and non-adopters in figure 1. The distributions are almost identical and only a few observations are outside the region of common support. There is sufficient overlap in the propensity scores of adopters and non-adopters to perform the matching in the region of common support. To test the quality of the matching, we performed a balancing test with the propensity score based on the nearest neighbor matching estimator for pea revenue (see table 10). After the matching, there are no systematic and statistically significant differences in observed characteristics between adopters and non-adopters. Matching is considered successful if

it results in a standardized difference in the mean values less than 25% (Imbens and Wooldridge 2009). Our data meets this criterion after matching. Both tests suggest that we have a good quality of matching and that the overlap assumption is met. Conditional independence cannot be tested directly. We condition on a range of observable covariates to control for selection on observable characteristics.

Sensitivity test

To test the sensitivity of the results towards hidden bias, we calculate Rosenbaum bounds (see table 11). Rosenbaum bounds estimate a critical value of gamma at which the treatment effect becomes insignificant. For significant treatment effects, the critical values are between 1.5 and 1.9. This means that matched farmers with the same observed characteristics would have to differ in unobserved characteristics by a factor of 1.5 to 1.9, or by 50% to 90%, in order to question the significance of the identified ATT (Chiputwa et al. 2013; Abebaw and Haile 2013). There is no reference for a critical threshold under which the results become unstable. But, after assessing the magnitude by which the farmers would have to differ in unobserved characteristics, we consider our results quite robust with regard to hidden bias.

Table 10 Balancing test

	Treated	Control	%bias[a]
Age	43.985	45.203	-9.7
Age2	2088.7	2215.1	-10.9
Education	4.649	4.687	-1.3
Education2	30.216	31.757	-3.9
N_On_farm	3.836	3.687	7.3
land_owned_before2009	0.872	0.751	7.2
all_title3	0.769	0.746	5.1
irri_dummy	0.194	0.209	-3.8
BuyerFFV	0.849	0.852	-0.7
AssetScore2	0.037	0.008	2.2
Livestock_NR	0.940	0.987	-5.9
Mothertongue	0.059	0.059	0
Exporter_before_2009	0.358	0.375	-3.9
AccessCreditFormal	0.366	0.334	6.7
mean_exp	11.162	11.395	-2.9
share_peas	38.384	39.544	-6.3
cost_to_market_dollarxkg	0.005	0.004	6.8
FLX	0.249	0.112	6.9

a Normalized difference; Whole sample (n=276); based on nearest neighbor matching (4)
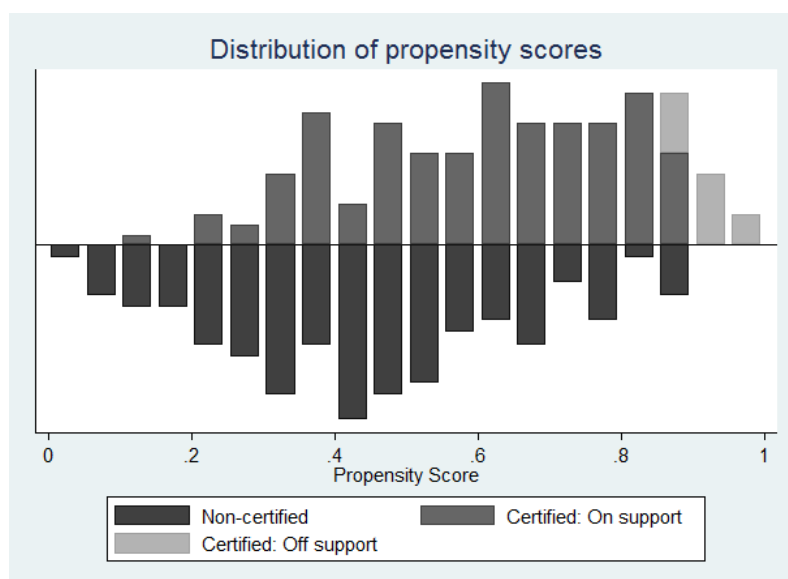
Figure 1 Distribution of the propensity scores for the whole sample (N=276)

Table 11 The impact of GlobalGAP

	Pea revenue	Bound[b]	Effect	Total agricultural revenue	Bound[b]	Effect	Total Income	Bound[b]	Effect
NNM (4)[a]	0.417*** (0.134)	1.9–2.0	52.2%	0.304* (0.158)	1.5–1.6	35.48%	0.306** (0.134)	1.5–1.6	35.6%
RM (caliper 0.05)[c]	0.338** (0.158)	1.6–1.7	46.2%	0.108 (0.157)	1		0.148 (0.148)	1.1–1.2	
KBM (bandwidth 0.06)[c]	0.342** (0.158)	1.6–1.7	40.5%	0.181 (0.145)	1		0.161 (0.161)	1.1–1.2	

Significance level at $^{*} p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$

a Bias adjusted standard errors; common support imposed
b Bounds are calculated based on the results of the -psmatch2- command, which does not take into account estimated propensity scores for standard errors
c Radius and kernel matching on the region of common support; no bias-adjusted standard errors

The impact of GlobalGAP adoption

To identify the ATT of GlobalGAP adoption on our outcomes of interest, we employ the three above introduced matching estimators. All three matching estimators report a positive and significant treatment effect of GlobalGAP adoption on pea revenue (see table 11). The ATT for GlobalGAP adoption on total household income is only significant with the nearest neighbor estimator. The interpretation of the estimated coefficients is not straightforward since we are using the natural logarithm of income as an outcome variable. We want to assess the effect of the change from not being certified to being certified.[24] The increase in revenue from pea production due to GlobalGAP adoption ranges from 40.5% with the kernel-based estimator to 52.2% with the nearest neighbor estimator. Total agricultural revenue and total household income are increasing by about 35% through GlobalGAP certification. This result is less robust as only the NNM estimator identifies a significant treatment effect. The results confirm our initial assumption that adoption has a positive ATT on farmers' pea revenues. The positive effect of GlobalGAP adoption on total household income cannot be completely confirmed.

Impact pathways

Which impact pathways explain the impact of GlobalGAP on pea revenue? The GlobalGAP scheme does not include a price premium for compliance. But our descriptive results show that certified farmers benefit from a more beneficial pricing scheme. Exporters offer premium prices and minimum or fixed price schemes in order to make certification more attractive and avoid side-selling. Certified farmers benefit from higher average prices, but prices do not fluctuate as much. The positive impact of GlobalGAP on pea revenue might therefore result from a price effect. Still, we also see that GlobalGAP producers generally deliver more to their exporters. On average, non-certified farmers have smaller farms than certified farmers. But the farmers do not differ in their specializations - both groups assign around 37% of their cultivated land to pea production. The higher volume delivered may be due to higher absolute cultivation land or to higher yields resulting from better production management, more efficient input use and

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[24] If the treatment variable GlobalGAP switches from 0 to 1, the percentage impact needs to be interpreted with care as our outcome variables are log-transformed. According to Halvorsen and Palmquist (1980), the effect of GlobalGAP on the outcome of interest is calculated as follows: 100*[exp*(coefficient) – 1].

better extension service. Improvement in farmers' marketing situation might also explain the volume effect. First, GlobalGAP comes with a contract scheme. These contracts often define the volume demanded by the exporter. Second, the improvement in product quality through GlobalGAP may lead to a lower rejection rate. Hence, the higher revenue from pea production for GlobalGAP certified farmers might also result from a volume effect.

But why does the strong ATT on pea revenue not translate into an increase in total agricultural revenue and total household income? Albeit the specialization in pea production is the same for certified and non-certified farmers (see table 1), standard adoption might require more capital and labor, which comes at the cost of producing other crops (intensification vs. diversification of the production base). GlobalGAP compliance is time and labor intensive; this might also come at the cost of lower engagement in off-farm activities, for example. Around one-third of the certified farm households do not report any off-farm income during the period surveyed. Qualitative evidence from the field supports this impact pathway: Farmers state that they do not necessarily feel a quantitative improvement in their overall economic situation, but that they do benefit from more economic security and stability.

6.2 The impact of GlobalGAP and financial literacy

Other studies have shown the importance of considering the heterogeneity of farmers when assessing the impact of standards/innovations on the economic situation of small farmers (Holzapfel and Wollni 2014; Mendola 2007; Hansen and Trifković 2014). In our study we consider heterogeneous financial literacy skills in the assessment of the income effect of GlobalGAP adoption. We assume that the impact of GlobalGAP depends on the individual farmer's financial skills. Furthermore, higher financial literacy might allow a farmer to better translate certification into economic benefits.

Estimation of the propensity score

The probit model for estimating the propensity scores for both subsamples is specified without financial literacy as a covariate. Another covariate is dropped (BuyerFFV) due to multicollinearity problems in the subsample. We replace the variable with a dummy that indicates whether there is a local market in the village where the farmer lives. This is a proxy for access to marketing opportunities, which is similar to the BuyerFFV-

variable. The determinants of GlobalGAP adoption differ between the two groups (see table 12). For farmers with a higher level of financial literacy, the only significant determinant is whether they were already working with an exporter before 2009. For the low financial literacy group, assets, exporter before 2009, transportation costs and experience significantly influence GlobalGAP adoption.

Table 12 Propensity scores of GlobalGAP adoption for high and low financial literacy subsample

	GlobalGAP High FL subsample		GlobalGAP Low FL Sample	
Age	0.055	(0.086)	-0.0615	(0.059)
Age2	-0.0001	(0.001)	0.001	(0.001)
Education	0.08	(0.125)	-0.023	(0.133)
Education2	-0.008	(0.008)	0.0019	(0.014)
MembersOnFarm	0.094	(0.068)	-0.039	(0.068)
Ha owned before 2009	0.279	(0.177)	-0.03	(0.082)
Land title	0.118	(0.333)	0.168	(0.274)
Irrigation	0.037	(0.374)	0.038	(0.339)
FarmX	0.216	(0.132)	0.204*	(0.106)
Livestock_NR	0.088	(0.179)	0.195	(0.158)
LocalMarket	0.363	(0.303)	0.054	(0.269)
Mother tongue	0.225	(0.672)	-0.437	(0.516)
Exporter before 2009	0.930***	(0.309)	0.825***	(0.271)
Formal credit access	0.191	(0.300)	0.264	(0.238)
Experience pea production	-0.019	(0.019)	-0.034**	(0.017)
Specialization	0.001	(0.007)	0.001	(0.007)
T_costs	-2.271	(43.67)	-65.53*	(36.20)
Constant	-1.840	(1.876)	1.127	(1.371)
Observations	130		146	

Standard errors in parentheses * $p<0.10$, ** $p<0.05$, *** $p<0.010$

Common support

As we did for the complete sample, we test whether the overlap assumption holds for the two subsamples by performing matching and displaying the distributions of the propensity scores. According to the distribution of the propensity scores of GlobalGAP adoption for GlobalGAP adopters and non-adopters in the high and low financial literacy subsamples, we have sufficient overlap and very few observations outside the region of common support (see figures 2 and 3). There is sufficient overlap in the propensity scores of adopters and non-adopters to perform the matching on the region of common support. To test the quality of the matching, we performed a balancing test with the pro-

pensity score for the subsamples based on the NNM estimator for pea revenue (see table 13). After matching, there are no significant differences between the treatment and control group for both subsamples. The standardized difference in the mean values is less than 25% for both groups. The overlap assumption is met for both subsamples, so we can do the propensity score matching.

Table 13 Balancing test for subsamples (based on NNM for nearest 4 neighbor estimator)

	High levels of FL			Low levels of FL		
	Treated	Control	%bias	Treated	Control	%bias
Age	41.918	41.902	0.1	46.695	47.174	-3.5
Age2	1864	1850.1	1.4	2380.4	2432.2	-4
Education	5.279	4.918	11.5	3.576	3.958	-16
Education2	36.852	29.484	13.8	18.525	22.873	-18.9
MembersOnFarm	3.869	3.844	1.1	3.610	3.542	3.6
Ha owned before 2009	0.460	0.479	-1.1	0.691	0.810	-7.6
Land title	0.771	0.783	-2.9	0.712	0.703	1.9
Irrigation	0.180	0.159	5	0.169	0.174	-1.1
LocalMarket	0.433	0.438	-1.2	0.339	0.367	-5.8
FarmX	-0.027	-0.058	2.3	-0.146	-0.018	-10.3
Livestock_NR	0.918	0.979	-7.7	0.881	0.788	12.1
Mother tongue	0.049	0.025	9.7	0.051	0.098	-20.5
Exporter before 2009	0.344	0.295	11.2	0.305	0.284	4.9
Formal credit access	0.328	0.295	7.1	0.407	0.386	4.3
Experience pea production	11.316	10.792	6.8	10.475	11.154	-8.4
Specialization	41.528	41.262	1.4	35.834	39.272	-19.5
T_costs	0.004	0.004	8.6	0.004	0.004	18.7
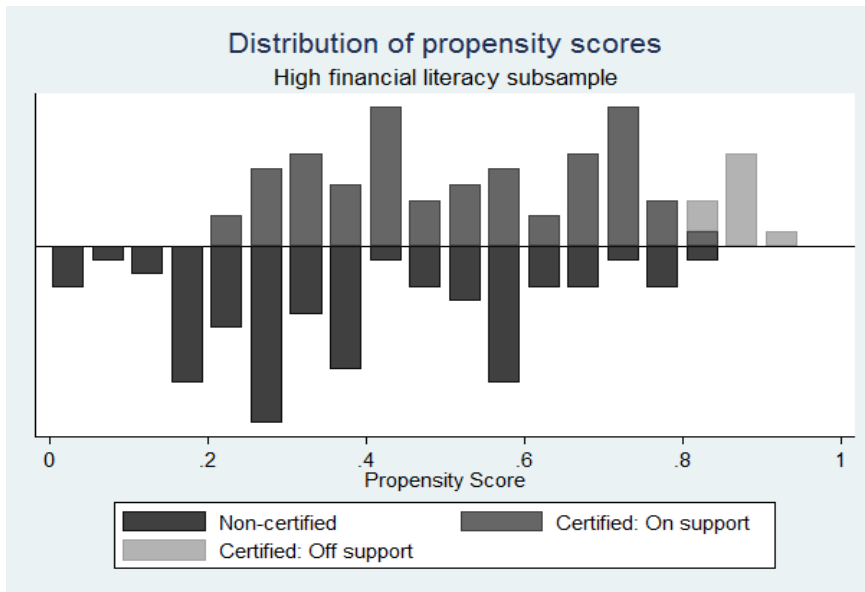
Figure 2 Distribution of propensity scores: High financial literacy subsample
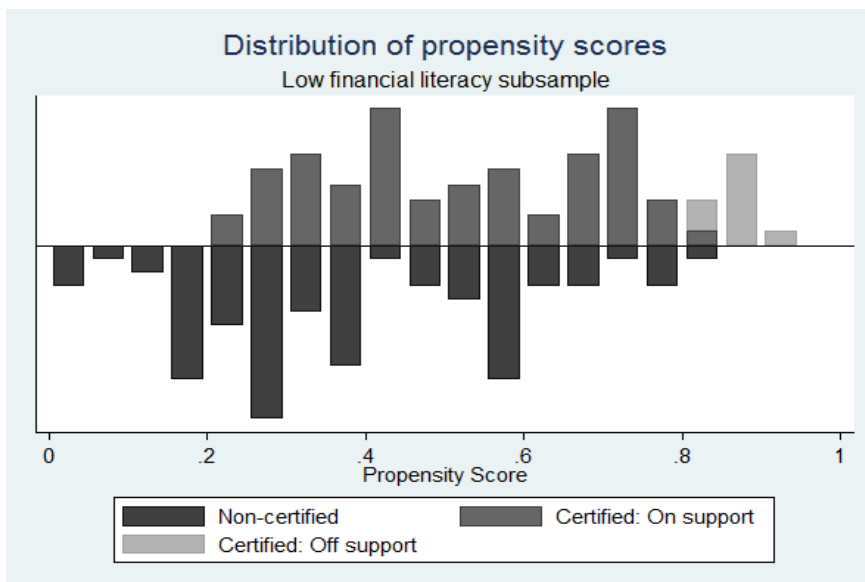
Figure 3 Distribution of propensity scores: Low financial literacy subsample

Matching and sensitivity test

We use three different matching estimators again to test the robustness of the results. The NNM, the RM and the KBM estimators all yield similar results for the identified ATT (see table 14). Thus, we identify a significant and positive impact of GlobalGAP adoption on income from pea production for the high financial literacy subsample. The Rosenbaum bounds confirm the stability of the results: The farmers would need to differ by 100%−120% in unobservable characteristics in order to invalidate the results. Certification increases revenue by 67%−78% for farmers with higher financial literacy skills. For the low financial literacy group adoption has no significant treatment effect. This result suggests that the impact of GlobalGAP on farm revenue is indeed different for different financial literacy levels. Farmers benefit only from the standard if they have a high level of financial literacy. Even if farmers undertake the efforts of standard adoption, this does not automatically lead to an improvement in their economic situation. The farmers in our sample with low financial literacy levels do not benefit from GlobalGAP adoption. This indicates that private standards such as GlobalGAP are exclusive in that farmers need to have a certain cognitive level in order to benefit from compliance.

Table 14 The impact of GlobalGAP on pea revenue acoording to financial literacy groups

Pea revenue	NNM (4)[a]			RM (caliper 0.05)[b]			KBM (bandwidth 0.06)[b]		
	Coeff (sd)	Effect	Bounds	Coeff (sd)	Effect	Bounds	Coeff (sd)	Effect	Bounds
High FL (n=107)	0.519** (0.207)	67,9 %	2– 2.1	0.578** (0.224)	78.2 %	2– 2.1	0.58** (0.225)	78.6 %	2.1– 2.2
Low FL (n=136)	0.225 (0.239)			0.203 (0.227)			0.184 (0.234)		

Significance level at [*] $p < 0.10$, [**] $p < 0.05$, [***] $p < 0.01$

a Bias-adjusted standard errors; common support imposed

b results based on -psmatch2-command; common support imposed; no corrected standard errors

We also calculated the heterogeneous impact of GlobalGAP on total household income and revenue from agricultural production. The ATT on our outcome variables in the two financial literacy categories is not significant for the three matching estimators employed, so we do not report it in this paper. It seems that overall the strong positive ef-

fect of GlobalGAP on financially literate farmers does not translate into an overall effect on total household income.[25]

Impact pathways

Financially literate farmers seem better able to translate GlobalGAP adoption into economic benefits through their cognitive skills. But what can explain the strong and heterogeneous impact of GlobalGAP on pea revenue? Referring to our conceptual framework (outlined in section 2), financial literacy might influence the impact through cognitive and non-cognitive effects.

The cognitive effect of financial literacy on farm income may work through different channels. In the descriptive results, we saw that highly financially literate farmers are on average better educated. Due to their higher educational and higher financial literacy levels, they may be more used to applying numerical or financial concepts in their farm management. This would help them in the efficient use of farm inputs, credits and capital. They might also be more able to adequately use the information provided by the standard, the standard setter and the extension environment. This would lead to better management of the farm processes and closer compliance, which in turn might allow farmers to produce more consistently high quality products. Better and more consistent quality might lead to better prices. It may also be that exporters have to invest less into the compliance of financially literate farmers and reward this with a higher price. As we have seen in the descriptive results, on average farmers with higher scores on the financial literacy index receive a better price, deliver more produce and have more contracts compared to farmers with a low level of financial literacy. If we look at the certified sample only, those with a higher financial literacy level receive the same average price as farmers with a low financial literacy level, but they have higher price ranges.

The non-cognitive effect of financial literacy may influence the income through farmers` attitude and their bargaining ability. Highly financial literate farmers tend to be younger, so they may be more open towards new technologies and more flexible in their way of thinking. Another impact pathway of financial literacy on economic outcomes may be through farmers' bargaining ability. Having more accurate knowledge of the

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[25] Results upon request.

financial situation of their own farm businesses and understanding prices, interest and inflation may improve farmers' bargaining position. This may lead to higher prices for their products.

Our descriptive results also show that those with a high financial literacy level have easier access to marketing options for their product and work in an environment with more competition among buyers. This might lead to better prices with the exporter. Exporters might have an incentive to pay more or go with the market price to avoid side-selling. Having a livelier commercial environment in the village may also offer more learning opportunities for farmers, so that they can further improve their financial abilities.

7. Conclusions

Smallholder farmers from developing countries are confronted with complex regulations and requirements for their products and production processes. High quality, safe and healthy food and sustainable production processes are demanded by consumers around the world, mostly in developed countries. This demand translates into the emergence of certification systems and standards, which have become more or less mandatory and regulate access to international high-value chains. Increasing incomes and the formation of a broader middle class in many developing countries and transition economies fuel these trends. So far there is still no clear and undisputed answer as to whether small farmers benefit from this trend. Empirical evidence suggests a positive impact on the economic and household well-being of small farmers - but the impact is not the same for all the farmers. We contribute to the discussion about the heterogeneity of standards' impacts by considering financial skills in measuring the economic impact of a food safety and quality standard, GlobalGAP.

In this paper, we analyzed the impact of GlobalGAP adoption on the economic situation of small pea farmers in the Guatemalan highlands. By using matching techniques we showed the positive impact of GlobalGAP on revenue from pea production, total agricultural revenue and the total household income of pea farmers in Guatemala. Certified farmers benefit from beneficial price schemes and a more secure marketing situation with binding agreements. The impact of GlobalGAP is heterogeneous depending on the financial literacy level of the farmers: GlobalGAP has a strong and significant positive

effect on revenue from pea production for farmers with higher financial literacy skills; for farmers with lower financial literacy skills, the impact disappears. We do not detect any significant impact of GlobalGAP on total household income when we stratify our sample into two groups based on financial literacy (high and low). To check the sensitivity of our results towards hidden bias, we calculated Rosenbaum bounds. The use of three different matching estimators confirms the robustness of our results. Financial literacy seems to enable farmers to better translate GlobalGAP adoption into economic benefits. Our results confirm our initial assumption that the impact of food safety standards might be heterogeneous for differently skilled farmers.

Our results hold important managerial and policy implications. Exporters are interested in the continuous and reliable standard compliance of farmers. This allows exporters to constantly deliver high quality, safe products to their buyers, who are mainly in Europe or the US. Clear benefits from standard adoption are a strong incentive for farmers to adhere to the standard. By improving farmers' financial and other business-related skills via extension services and trainings, benefits from organizational innovations such as GlobalGAP could become more visible to those farmers. In this sense, this study of the role of financial literacy has revealed an important starting point for increasing the attractiveness of certification and farmers' willingness to comply with standards.

Integration into high value chains is seen as a means to alleviate poverty and foster rural development (FAO 2014). Public institutions and non-governmental organizations are, therefore, increasingly interested in the implementation of public and private food safety and quality standards in order to improve market integration of small farmers in developing countries. Training farmers in financial and business-related skills could help them benefit more from new technologies and decrease their vulnerability in the competitive environment of global value chains. Standards might have positive impulses for farm household well-being and rural development—as long as farmers have the necessary skills to use new technologies for their own benefit. Thus, the study also provides a starting point for political decisions and administrative actions aiming at rural development and poverty alleviation.

Similar to most studies on the impact of the adoption of organizational innovations in food supply chains, there are also some shortcomings. One important shortcoming of the results is the potential endogeneity of GlobalGAP adoption. We control for this in

our analysis by matching on the area of common support, testing the balancing property and calculating Rosenbaum bounds of hidden bias. This reduces bias in the results, but does not completely eliminate it. Future research should take this problem into account.

Nevertheless we come to interesting results by exploring the role of financial literacy in innovation adoption. It is important to consider farmers' financial and other business-related skills in order to better understand how new technologies like food safety and quality standards impact farm level. Future research should deepen the understanding of how cognitive skills influence the economic impact of new technologies. The ongoing modernization and transformation of the global food system increasingly requires the ability of farmers and other supply chain actors to adapt to a new business environment. Ensuring the ability of farmers to make use of the opportunities provided to them by this development is vital in creating benefits and improving resilience.

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9. Appendix

A1 Numeracy and financial literacy test

If there is a possibility of 10% of getting ill, how many persons out of 100 would get ill?

Five persons have bought the winning number in a lottery. The prize is 2,000 quetzals. How much will each winner receive?

Imagine you had 1,000 quetzals in a savings account. The annual interest rate is 2% (20 quetzals in the first year). After five years, how much will you have in the saving account if you do not touch the money?

- More than 1020 quetzals
- Exactly 1020 quetzals
- Less than 1020 quetzals

Imagine that your income will double next year. The prices of all the products that you consume will also double. With your income, how much will you be able to buy next year?

- More than this year
- The same as this year
- Less that this year

The bank has leant you 3,000 quetzals; the interest rate is 1% every month. If you pay 30 quetzals every month, when will you have paid back the loan?

- In less than five years
- In less than ten years
- Never

Imagine you get a loan of 1,000 quetzals from the bank. Which option is better for you?

- To pay 5% interest every month
- To pay 24% interest a year

A2-1 Principal component analysis for the financial literacy index

Table A-1 Principal components for financial literacy

Principal components/correlation
Number of obs.   =   277
Rotation: (unrotated = principal)
Rho   =   1.0000

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	4.10547	3.30873	0.6842	0.6842
Comp2	0.796745	0.373399	0.1328	0.8170
Comp3	0.423346	0.15087	0.0706	0.8876
Comp4	0.272477	0.0172805	0.0454	0.9330
Comp5	0.255196	0.108431	0.0425	0.9755
Comp6	0.146765	0.	0.0245	1.0000

Table A-2 Factor loadings for component 1

Principal components (eigenvec-
tors)

Variable	Comp1
Probability skills	0.3610
Division skills	0.3033
Interest	0.4553
Inflation	0.4363
Credit repayment	0.4187
Interest2	0.4524

Table A-3 Kaiser-Meyer-Olkin measure of sampling adequacy

Variable	KMO
Probability skills	0.8972
Division skills	0.8668
Interest	0.8617
Inflation	0.9122
Credit repayment	0.9283
Interest2	0.8698
Overall	0.8888

Table A-4 Bartlett's test of sphericity

Chi-square	1163.503
Degrees of freedom	15
p-value	0.000

A2-2 Principal component analysis for asset index

Table A-5 Principal components for the asset index

Principal components/correlation

Number of obs.   =   277

Rotation: (unrotated = principal)

Rho   =   1.0000

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.84616	0.429529	0.1420	0.1420
Comp2	1.41664	0.139036	0.1090	0.2510
Comp3	1.2776	0.0526699	0.0983	0.3493
Comp4	1.22493	0.16598	0.0942	0.4435
Comp5	1.05895	0.0197427	0.0815	0.5249
Comp6	1.03921	0.140667	0.0799	0.6049
Comp7	0.89854	0.0263536	0.0691	0.6740
Comp8	0.872187	0.0525365	0.0671	0.7411
Comp9	0.81965	0.105628	0.0671	0.7411
Comp10	0.714022	0.015416	0.0549	0.8591
Comp11	0.698606	0.0892119	0.0537	0.9128
Comp12	0.609394	0.0852783	0.0469	0.9597
Comp13	0.524116		0.0403	1.0000

Table A-6 Factor loadings for component 1

Principal component 1 (eigen-vectors)

Variable	Comp1
Car	0.1752
Pickup	0.3797
Motorbike	0.1257
Bike	0.0525
Truck	0.3073
Knapsack sprayer	0.2996
Knapsack manual	0.1785
Irrigation	0.3449
Reservoir	0.3278
Storage silo	0.1088
TV	0.3500
Radio	0.2796
Mobile	0.3895

Table A-7 Bartlett's test and KMO

Bartlett's test of sphericity

Chi-square	1163.503
Degrees of freedom	15
p-value	0.000
KMO	0.560

A3 Analysis

Table A-8 Variables used in the propensity score model

Age	Age of the household head in years
Age2	Age of household head in years squared
Education	Years of formal education
Education2	Years of formal education squared
MembersOnFarm	Family members working on-farm
Ha owned before 2009	Hectares of land owned before 2009
Land title	Dummy 1= land title, 0 otherwise
Irrigation	Dummy 1= using irrigation, 0 otherwise
BuyerFFV	Dummy 1 = Buyer for fresh products in the village, 0 otherwise
LocalMarket	Dummy 1 = Local market in the village, 0 otherwise
FarmX	Farm asset index
Livestock_NR	Number of livestock owned
Mother tongue	Dummy 1 = Spanish 0 = Indigenous language
Exporter before 2009	Dummy 1 = delivered to exporter already before 2009, 0 otherwise
Formal credit access	Dummy 1 = Access to formal credit, 0 otherwise
Experience pea production	Years of experience in pea production
Specialization	Percentage of land dedicated to pea production
T_costs	Transportation costs dollar per kg per km transported good
FLX	Financial literacy index
Treatment variable	1 = GlobalGAP 0 otherwise

General conclusions

The overall objective of this thesis is to contribute to the discussion on the role of food safety standards for small-scale farmers in developing countries. The thesis consists of four papers that contribute to the research objective.

The first paper of the thesis introduces two theoretical approaches – cluster and global value chain analysis – that are widely applied to analyze organizational patterns between economic actors. Cluster analysis is used to analyze the economic organization of geographical agglomerations whereas global value chain analysis is concerned with the economic organization of globally dispersed actors connected through their vertical trade relationships. Both concepts have shortcomings: Cluster analysis does not look at the global, vertical influences whereas value chain analysis neglects the importance of the local or regional context of actors. The paper illustrates the merit of combining the two perspectives when it comes to analyzing determinants of small farmers' participation in high-value markets or the effects of organizational changes in global value chains on small farmers in developing countries.

The second paper discusses different aspects of food safety standards with a special focus on the developing country context. Categorizing standard systems according to the standard setters, scope and objectives helps to better understand adoption determinants and economic impacts. Food safety and quality is a credence good, which comes with high information asymmetries within the value chain. The paper argues that the shift towards private certification systems is partly due to a general policy shift, which leaves the responsibility for food safety and quality with private actors, such as producers, processors, and retailers. Standards are used as a tool for risk management and product differentiation. They are applied to meet the exigent demand of informed consumers and stakeholders. The paper furthermore discusses the role of private standard schemes for developing countries with a special focus on adoption determinants and economic impacts.

The core of the thesis consists of two papers that analyze primary data from a random sample of small pea farmers in Guatemala. The third paper studies the determinants of GlobalGAP adoption in the fresh pea sector in Guatemala. The sector is characterized by small-scale farming and has a long tradition of sanitary and phytosanitary problems. Regardless of the increasing importance of food safety and quality in high value chains, the compliance with GlobalGAP is relatively low. The study shows that apart from

capital endowment and access factors, financial literacy plays a significant role in standard adoption. Farmers with a higher level of financial literacy are more likely to adopt GlobalGAP compared to those farmers with a lower level of financial literacy. It seems that farmers with higher skills are better able to comply with the stringent criteria of the standard which improves their adoption probability. Furthermore, the results suggest that informal sources of learning and knowledge are important for the formation of skills necessary for standard adoption.

The economic impact of GlobalGAP on small pea farmers in Guatemala is subject of paper number four. The results indicate an overall positive and significant impact of standard adoption on pea revenue, total farm revenue and total household income. Certified farmers market their products under more favorable price schemes and benefit from a more secure and stable marketing situation due to contractual arrangements. By stratifying the sample into more and less financially literate groups, the study finds a heterogeneous economic impact of GlobalGAP. Farmers with high financial literacy skills benefit significantly from GlobalGAP adoption in terms of higher farm revenue, whereas there is no significant economic impact for low skilled farmers. The results suggest that even if farmers undertake the effort of standard compliance, they do not automatically benefit from standard adoption in economic terms. Only with a certain skill level farmers seem to be able to translate the standard adoption into economic benefits at the farm level.

Managerial and policy implications

Food safety and quality will continue to play an important role in global value chains and increasingly within developing and emerging countries themselves as the globalization and transformation of the global food system will continue (European Commission 2013). A growing world population will increase demand for food in general. With economic development and the formation of a broader middle-class with diversified lifestyles also in developing and emerging countries, demand for safe and high quality food will increase. The combating of undernourishment and hunger goes hand in hand with the provision of healthy and safe food (WHO and FAO 2014). New technologies in agricultural value chains, the liberalization of trade and the industrialization of agriculture will further increase the need of sound food safety policies (European Commission 2013).

Ensuring small farmers' compliance with international food standards is thus of high interest for different actors in developing countries like Guatemala. Exporters are interested in complying with the demand of competitive international markets and require standard adoption from their suppliers. As exporters often have to bear main parts of the investment costs for standard adoption, it is of high interest for them to have successful and continuous adoption of standards by farmers in order to recover the investment. Development policy and non-profit development organizations are interested in food safety and quality for its important role for food security and sustainable agricultural development. Agriculture and economic policy aims at the development of a functioning national food quality infrastructure. The results of the thesis lead to managerial and policy implications for the different interest groups.

The first two papers lead to more general practical implications. The discussion shows the important role of vertical relationships within global value chains as well as horizontal relationships on the local level within clusters. Local differences (for example regarding the institutional setting, infrastructure or climatic conditions) and differences in the governance of the value chains (for example whether producers face many buyers or only have limited marketing possibilities) may influence standard adoption and impact. The objective, design or the scope of the standard influence how standards are adopted by small farmers as well as how they impact in economic terms. Standards that include a price premium or allow for local adaptation of the scheme may affect outcomes very differently. For practitioners working on the implementation of food safety standards among small farmers it is essential to analyze and understand the local and global context that surrounds the target group as well as the standards themselves. Only a well-grounded understanding of the context and the standards themselves allows effective actions.

The empirical evidence from papers three and four leads to more specific recommendations concerning the adoption and impact of food safety and quality standards. The results stress the important role of financial and business related skills in the adoption process as well as for a beneficial impact from standard adoption. When connecting small farmers to competitive global value chains, it is essential to have financial and business related skills as farmers have to take a more entrepreneurial perspective on their farm businesses. One important recommendation for public and private actors alike

is the focus on capacity building beyond traditional agronomic topics. This requires the use of extension staff that has knowledge in business and financial matters. Traditionally, extension service is done by technical personnel with a predominantly agricultural background. Exporters and the public sector (like the agricultural ministry) should adapt the requirements for extensionists accordingly. Small farmers are exposed and vulnerable to changes and shocks within global value chains as they have almost no influential power. Improved financial skills help farmers to have more resilient farm businesses. Overall, this contributes to the sustainable development of the small farm sector.

Another topic of practical relevance is the important role of informal learning for food standard adoption. The results suggest that skills necessary for standard adoption seem to be less related to formal schooling. This further stresses the important role of capacity building for standard adoption. Exporters and agricultural extensionists could create possibilities for informal learning like farmer field days or farmer field schools. Also within or between farmer groups, learning from others could be fostered through exchange of knowledge and experience. The results indicate that farmers with more experience in export markets are more likely to adopt GlobalGAP. A stepwise adaptation of farms towards the requirements of stringent export chains could foster learning by doing and learning through experience. Farmers could start by supplying less stringent, for instance domestic markets and then step by step implement more stringent food safety and quality measures necessary for high value chain participation. Improving financial and business related skills could also reduce farmers dropping out of the standard. These dropouts seem to occur mostly when the supporting institutions withdraw their financial support for the farmers. Being equipped with the necessary financial and business related skills may enable the farmers to be more independent from the supporting institutions when it comes to standard adoption.

The increasing application of private standard systems in agri-food chains should not leave behind the discussion about the role of the public sector. Food safety and quality is a public good that is not provided in many developing countries such as Guatemala. Private standards like GlobalGAP step into this regulatory gap. The public sector should take a leading role in providing a functioning institutional system that guarantees safe and healthy food for all. With a working quality infrastructure, the adoption of private standards will take less effort, will be less costly and less exclusive and will be more

beneficial for small farmers. Efforts of the public sector and international donors should take this into account: capacity building and technological upgrading at the farm level should be accompanied by institution building. In the end, a working public and private quality infrastructure contributes to food safety, food security and sustainable agricultural development.

Limitations and further research

The presented research counts with some limitations that should be addressed by further research. Financial literacy is possibly endogenous. Unobserved factors such as intelligence or ambition may drive financial literacy and the outcome alike. A common approach to reduce biased results caused by endogeneity is the use of an instrumental variable approach. The internal validity of the results may be weakened as an adequate instrument is missing. Further research interested in the role of financial literacy in innovation adoption should consider the endogeneity bias in the research design, for example by using experimental approaches. The case studies use an index as an aggregate measure of financial literacy. In order to further improve the knowledge of how financial literacy influences standard adoption it would be useful to use a more disaggregate measure. This allows seeing specific effects for different financial literacy groups or to analyze which components of financial literacy are helpful in the adoption process. The results could lead to more concrete policy recommendations better tailored to the needs of specific farmer groups.

GlobalGAP adoption is a non-random process – farmers self-select into the standard on the basis of unobserved characteristics. The empirical studies present methods to reduce the bias due to self-selection into the standard (bivariate probit model and propensity score matching) but the self-selection bias is not completely eliminated. The use of panel data or experimental approaches like randomized control trials could help to reduce bias caused by self-selection into the standard program.

Food safety and quality will play an important role in the future agri-food system. Albeit we already count with various studies about this topic, there is still a need to further understand the trend and its implications for developing countries. Small-scale farmers in developing countries reach standard adoption through group certification. The case studies in this thesis use farm-household data in order to understand the adoption pro-

cess. Group-level effects are not considered but might play a role in the process. The size of the group, the experience of the group in working with the export sector, its capitalization and the level of interaction within the group might also influence standard adoption of individual farmers. Another impression from the field leads to the assumption that there are local clusters of standard adoption. Other studies find similar patterns of spatial clustering of innovation adoption (Wollni and Andersson 2014). In order to deeper understand the spatial dimension of standard adoption, the diffusion of innovations on the local level could be analyzed. Combining the group level and spatial perspectives to a spatial network analysis may lead to further interesting research insights with important implications for regional development strategies. There could be a certain threshold of farmers within a farmer group or within a village above which the adoption of a food standard is more reasonable due to economies of scale, stronger learning effects and spillovers. Strong farmer groups could also be a means to overcome spatial disadvantages like remoteness or missing access to information and infrastructure. The dataset used for the thesis contains geospatial information that could be exploited for this purpose. The challenge lies in obtaining the missing group level data. The support-structure that is created around the certification of small-farmers raises the question about the sustainability of the trend. One aim of development policy and exporters is the sustainable adoption of standards also in the absence of a complex supporting environment. Focusing on the role of spatial networks in continuous standard adoption over time could give valuable insights. This would require the availability of panel data, ideally collected over a longer period of time to see the effects. [26]

Countries like Guatemala exhibit a highly dualistic agricultural sector with a modern, technology-intensive export sector operating according to stringent food safety regulation and a traditional sector producing for the demand within the country that is barely regulated. This raises the question about the fairness of the current agri-food system. For a sustainable agriculture-based and inclusive growth, policy needs to overcome the dualism of the sector. An important question for research is thus how to overcome the dualistic structure of the agricultural sector in order to provide safe food for all. As ar-

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[26] Holzapfel and Wollni (2014) is the only study that looks at the dynamics of GlobalGAP adoption with panel data. The data consists of two survey rounds in two consecutive years and thus might not capture the long-term trend in standard adoption.

gued before, well working institutions are crucial for this process. But the role of institutions in the increasing standardization of agriculture in developing countries has not gained much attention yet. One important topic in the literature is the interplay between public and private food safety regulations in developing countries. There is missing knowledge on how the increasing standardization affects the public quality infrastructure – are there positive spill-overs or is there a crowding-out of public responsibility?

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Declaration of originality

1) I, hereby, declare that this Ph.D. dissertation has not been presented to any other examining body either in its present or a similar form.

Furthermore, I also affirm that I have not applied for a Ph.D. at any other higher school of education.

Göttingen, …………………………..

…………………………………………

(Signature)

………………………………………….

(Name in block capitals)

2) I, hereby, solemnly declare that this dissertation was undertaken independently and without any unauthorized aid.

Göttingen, ………………………………..

……………………………………………...

(Signature)

……………………………………………………

(Name in block capitals)

Appendix 1 Survey instrument

GlobalFood
www.uni-goettingen.de/globalfood

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Encuesta
"Adopción de estándares de calidad y impactos a pequenos productores de arveja
en el área de Chimaltenango y Sacatepequez, Guatemala"
Agosto a Octubre de 2012
Realizado por el proyecto GlobalFood de la Universidad de Göttingen, Alemania
Coordinadora responsable: Anna K. Müller

0. Introduction

0,01	Fecha de entrevista	
0,02	Código del entrevistador	
0,03	Número de boleta	
0.04	Lugar de entrevista: Casa=1/Sede=2	
0,05	Departamento	
0,06	Municipio	
0,07	Aldea	
0,08	Inicio de entrevista	
0,09	Final de la entrevista	

Coordinadas de la resdencia del encuestado

0,10 N/S _____ °

0,11 West _____ °

0,12 Altura _____ metros

Informaciones sobre el encuestado (Preguntar hasta el final de la entrevista)

0,13 Nombre encuestado	
0,14 Dirección	
0,15 Aldea	
0,16 Municipio	
0,17 Departamento	
0,18 Número de telefono	

Grupo de Trata-miento (Certifcado)	Grupo de control 1 (no certificado, organiza-do)	Grupo de control 2 (no cerificado no organi-zado)
☐	☐	☐

1

Sección 1 Informaciones sobre el hogar

Por favor, brinde informaciones sobre los miembros que formaron parte del hogar durante el tiempo de junio 2011 a Julio 2012. (Nota: Miembros del hogar son todas las personas, que usualmente comen de la misma olla y duermen bajo el mismo techo. Incluye también miembros que estuvieron ausentes por menos de dos meses en los últimos doce meses.)

ID-Code	Primer nombre (no entra a la digitación de los datos)	Relación con el jefe del hogar (Código 1.02)	Sexo M=1; F=2	Edad en años	Cual es la lengua materna __ leer y escribir en español ? (Código 1.04)	¿Sabe escribir en educación no formal de __	Años de educación formal mas alto alcanzado de __ (Código 1.07)	El nivel de educación actualmente? (0=No;1=Si) (Código 1.09)	¿__ tra baja en la finca? (0=No;1=Si) días por semana	semanas por mes	meses por año	__ trabaja fuera de la finca o del hogar? (0= No;1=Si) No: omitir y seguir con 1.22	Por favor, especifica el tipo de ocupación (Código 1.14)	¿Cuánt os años trabajó en esta ocupaci ón?	¿Cuántas veces trabaja fuera de la finca o del hogar?	días al día por mes	seman as por sema na? por mes	meses por año	¿Cuánto es el ingreso promedio en Quetzales? (1 opción) por año (calcular después)
	1.01	1.02	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20	1.21
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			

En caso positivo, cuántos/cuántas

Solamente si la persona trabaja fuera de la finca o del hogar

Código 1.01:

1 Jefe
2 Esposa/Esposo
3 Hijo/hija
4 Padre/madre
5 Nieto/a
6 Abuelo/a
7 Yerno/nuera
8 Hermano/a
9 Cuñado/cuñada
10 Otro familiar
11 Otro no familiar

Código 1.09:

0 Ninguno
1 Primaria
2 Básico
3 Diversificado
4 Técnico Universitario
5 Universitario
6 Otro
0.99 No aplica (Niños menos de 6 años)

Código 1.4:

1 Español
2 Kaqchikel
4 si otra, especifica: _____

Código 1.09:

0 No trabaja en la finca
1 Jornada completa
2 A media jornada
3 Solamente en tiempo de la cosecha
4 Solamente el fin de semana y en las vacaciones
5 Ayuda de vez en cuando (Faena)
6 Otro, específica:
99 No aplica (Niños menores de 14 años)

Código 1.14:

1 Intermediario/ colector/comerciante de productos agrícolas
2 Jornalero/ jornalera en actividades agrícolas
3 Trabajador de tiempo completo en servicios y comercio (Incl. Flete,
4 Trabajador temporal en servicio y comercio
5 Empleado público
6 Trabajador eventual en servicio y comercio
7 Empleada doméstico
8 Otro (especifica):

155

Página 2 "Info Hogar 1"

Sección 1 Informaciones sobre el hogar

1.22 ID de miembro del hogar quien es principalmente responsable para decisiones en el área agrícola   1. _____

1.23 ID del miembro quien es principalmente responsable para decisiones financieras/de dinero (créditos etc)   1. _____

1.24 Recibe el hogar remesas de algún familiar que vive en el extranjero?   Si=1/No=0   ☐

Por si: 1.25 Cuanto recibe en promedio por año?   (1=Quetzales/2=Dolares)   _____   (Tipo de cambio Q 7.803/US$ 1.00)

1.26 Recibe el hogar dinero del programa Mi Bono Seguro (ex Mi familia Progresa)?   Si=1/No=0   _____

1.27 Recibe el hogar dinero del programa del adulto mayor?   Si=1/No=0   _____

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Página 1 "Recursos hogar 2"

Sección 2 Recursos del hogar

Preguntar por cada item. Si la persona encuestada no se acuerda del año cuando adquirio un item buscar puentes. Por ejemplo si en encuestado cuenta con dos bicis que compro en diferentes años se coloca el segundo iten en otros.

ID-Code	Cual de las siguientes cosas tenía usted o algun miembro del hogar en el tiempo del Junio 2011 al Julio 2012.	2.01 Que cantidad? (Ninguno=0)	2.02 En qué año lo adquirió?	2.03 Era nuevo cuando lo adquirió? (0=No; 1=Si)	2.04 Cual era el valor de compra en Quetzales/Unidad	2.05 ¿Cuanto valdría en el mercado si lo vendiera hoy?
	1) Vehiculos					
1	Carro					
2	Pickop					
3	Camionetilla					
4	Motocicleta					
5	Bicicleta					
6	Camión					
7	Tractor					
8	otro, especificar_____					
9	otro, especificar_____					
10	otro, especificar_____					
	2) Equipo e Infraestrcutura agrícola					
11	Bomba de mochila con motor					
12	Bomba de mochila manual					
13	Bomba de agua					
14	Sistema de riego (goteo/aspersión)					
15	Reservorio de agua para riego					
16	Bodega					
17	Silo/Sistema de almacenamiento de granos básicos					
18	Fumigadora parihuela					
19	otro, especificar_____					
20	otro, especificar_____					
	3) Otros					
21	Televisión					
22	Radio					
23	Computadora					
24	Telefono de línea fija					
25	Celular					
26	otro, especificar_____					
27	otro, especificar_____					

Sección 4 Producción

Por favor compartenos información sobre la producción agrícola en sus parcela por el tiempo de Junio 2011 a Julio 2012.

Instrucciones encuestador: Primero hacer un croquis de todas las parcelas del productor incluyendo el nombre de la parcela. También incluir parcelas que no están en uso agrícola pero si pertenecen de alguna forma al productor o su familia. Si el productor produce dos productos en la misma parcela usa el mismo código de parcela por los demás productos. También por cultivos asocios. Por favor indica entonces el área que ocupada un producto en la parcela. Se refiere a toda la producción, no solamente no-tradicionales!

ID	4.01	4.01	4.02	4.03	4.04	4.05	4.06	Primera cosecha				Segunda cosecha			
								4.07	4.08	4.09	4.10	4.11	4.12	4.13	4.14
	Nombre de la parcela (solamente uso interno) Ninguno=0	Cultivo (Código de Producto 4.01)	Área cultivado en cuerdas	En qué año empezó a cultivar este producto?	Es un cultivo asociado? Si=1/No=0	Usa sistema de riego Si=1/NO=0	Cuantas cosechas al año?	Temporada de cosecha (ej. 9- cuerda (hacer conversión si es necesario)	Rendimiento por cosecha en Quintales por cuerda (hacer conversión si es necesario)	De los Quintales cosechados, cuantos Quintales vendió	De los Quintales cosechados, cuantos Quintales vendió	Temporada de cosecha (ej. 9- cuerda (hacer conversión si es necesario)	Rendimiento por cosecha en Quintales por cuerda (hacer conversión si es necesario)	De los Quintales cosechados, cuantos Quintales vendió	De los Quintales cosechados, cuantos Quintales vendió

En el tiempo de Junio 2011 a Julio 2012, cuantos animales tenían en propiedad?

ID-Code	Animal	4.15	4.16	4.17
		Cual es el número de animales propios	Cual es el precio de mercado de un ___	Cuantos ___ vendió entre Junio 2011 a Julio 2012?
1	Ganado bovino			
2	Ganado caprino			
3	Ganado ovino			
4	Cerdos			
5	Aves			
6	Ganado equino			
7	Otros, especificar			
8	Otros, especificar			

Código de producto 4.01

1 Maíz
2 Fijol negro
3 Tomates
4 Papas
5 Café
6 Calabacín
7 Arveja China
8 Arveja Dulce
9 Arveja en granos
10 Ejote francés
11 Brocoli
12 Zanahoria
13 Mora
14 Fresa
15 Otra

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Página 1 "Costos variables 5"

Sección 5 Costos variables

Costos variables de producción (insumos variables)
Sección 5 Costos variables

Instrucción: preguntar por los cultivo mencionadas en la sección previa. Llenar la hoja por cada parcela. Siempre tomar en cuenta los varios cultivos que puede haber en una parcela. No diferenciamos los diferentes tipos de productos (p.ej. fertilizantes). Por si usaron varios productos sacamos el promedio de gastos.

Por favor, digame sobre los insumos que usó en sus parcelas durante el período de Junio 2011 a Julio 2012 (*o equivalente en las últimas dos temporadas*). Tambien sobre insumos orgánicos!

	5.01	5.02	5.03	5.04	5.05	5.06	5.07
Codigo del cultivo de la seccion de producción	Insumo	Cuantas veces aplica este producto por cuerda	Cantidad usada / cuerda		Costo/Unidad		Monto toal (Calcular despues de la entrevista)
			Cantidad	Unidad (Código 5.04)	Precio	Unidad (Codigo 4.04)	
Cultivo	**Pilon/Semilla**						
	Fertilizantes						
	Quimicos						
	Organicos						
	Foliares						
	Fungicidas						
	Insectidicidas						
	Herbicidas						
	Tutor						
	Pita						
Cultivo	**Pilon/Semilla**						
	Fertilizantes						
	Quimicos						
	Organicos						
	Foliares						
	Fungicidas						
	Insectidicidas						
	Herbicidas						
	Tutor						
	Pita						
Cultivo	**Pilon/Semilla**						
	Fertilizantes						
	Quimicos						
	Organicos						
	Foliares						
	Fungicidas						
	Insectidicidas						
	Herbicidas						
	Tutor						
	Pita						

Código 5.04: Unidades	
1 Quintal	5 Pilon
2 libra	6 Otro, esp_____
3 kilo	7 Tutor Unidad
4 litro	

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Página 1 "Otros costos 6"

Sección 6   Otros insumos variables

Instrucción: Si el productor da dos diferentes valores para un precio sacamos el pomedio (solamente para arveja.

Por favor compartenos información sobre los siguientes gastos que usted ha tenido en su producción agrícola durante el tiempo de Junio 2011 a Julio 2012

ID	En el tiempo de Junio 2011 a Julio 2012 usted cuanto gastó en … (No aplica=99)	6.01	6.02	6.03	6.04		
		Cuanto gasta cada vez que usa ___?		Cuantas veces por año está usando _____	Valor total (Calcular despues)		
		Quetzales	para cuanto tiempo (Código 6.02)				
1	Renta de maquinaria						
2	Gasolina para maquinaria propia					Código 6.02	
3	Reparación de maquinas propia					1 Hora	4 Mes
4	Gas para transporte					2 Día	5 anho
5	Transporte Público o privado					3 Semana	6 Medio dia
6	Renta de vehiculo						Otro
7	Agua						
8	Luz						
9	Almacenamiento de granos y vegetales						
10	Otros						
11	Otros						

Costos variables de trabajo

ID Code	En general, cuanto gastó en el tiempo de Junio 2011 a Julio 2012 en ___ (No aplica=99)	6.05	6.06	Cuantos están asalariados			
				6.07	6.08	6.09	6.10
		jornales por año	Numero de personas	Masculino	Quetzales/jornal	Femenino	Quetzales/dia
1	Preparación de la tierra						
2	Siembra						
3	Deshierbe						
4	Riego						
5	Applicaciones de químicos						
6	Applicaciones de fertilizante y abono						
7	Intalación de infraestructura (tutor y						
8	Cosecha						
9	Empaque						
10	Transporte						
11	Otros, esp. _____						
12	Otros, esp. _____						
13	Otros, esp. _____						

6.11   Cual es el pago promedio por un trabajador agrícola al día en esta región?   _____ Quetzales

6.12   Cual es el pago promedio por jornal por un día de trabajo no-agrícola en esta región?   _____ Quetzales

Página 2 "Otros costos 6"

6.13	Usted emplea trabajadores de tiempo completo en su finca?
	No=0/Si=1 _____

→ ¡No: Omitir pregunta!

por SI

ID Code	6.14	6.15	6.16	6.17	6.18	6.19
	Trabajadores masculinos			trabajadores femininos		
	No.	Salario mensual	Duración de empleo en meses	No	Salario mensual	Duración de empleo en meses
1						
2						
3						
4						
5						

Página 1 "Estandar 7"

Sección 7   Adopción de estándar y certificación

7.01   Actualmente, usted tiene alguna cerificación agricola? ___ *(0=No; 1=Si)*

Si respuesta es NO continua con la siguiente pregunta 7.11!
Si respuesta es SI: Despues sigue con pregunta 7.22

ID	7.02	7.03	7.04	7.05	7.06	7.07	7.08	7.09	7.10
	Con que certificación cuenta actualmente? (Código 7.02)	Cultivo *(Código 7.03)*	Tipo de certificación: 1= Individual 2= Grupo	Área certificada? En cuerdas	Quién le dio apoyo técnico y financiero con la implementación en su finca? (Código 7.06)	Cuando inició el proceso de certificación? *Ej. 8/2011*	Cuando obtuvo la primera vez la certificación? *Ej. 8/2011*	Indica si hubo años en los cuales no logró la certificación.	Indica los razones por los cuales no logro la certificación (Codigo 6.10)
1									
2									
3									
4									

Código 7.02: Estándar:	Código 7.06: Apoyo	Código 7.03: cultivo		
1 Globalgap	1 = Organismo internacional	1 Maiz	8 Arveja Dulce	
3 BRC /GFSI	2 =Exportadora	2 Frijol negro	9 Arveja en granos	
4 UE Organico	3 = Institución pública	3 Tomates	10 Ejote francés	
5 EE.UU Organico	4 = ONG	4 Papas	11 Brocoli	
6 Primuslab	5 = Fundacion Agil	5 Café	12 Zanahoria	
7 Fairtrade (Comercio Justo)	6= Grupo de	6 Calabacin	13 Mora	15 Otra
8 PIPAA	7= Otro	7 Arveja China	14 Fresa	
9 otro				

Si respuesta en 7.01 era NO:

7.11 Usted alguna vez ha sido certificado y decidió de abandonar la certificación? ___ *(0=No; 1=Si)*

NO: Continua con la siguiente pregunta 7.21

SI:

ID	7.12	7.13	7.14	7.15	7.16	7.17	7.18	7.19	7.20
	Con qué normas? (Código 7.02)	cultivo (Código 7.03)	Tipo de certificación: 1= Individual 2= Grupo	Área certificada? En cuerdas	Quién le dio apoyo técnico y financiero con la implementación en su finca? (Código 7.06)	Cuando inició el proceso de certificación? Mes y Año (9/2007)	Cuando obtuvo la primera vez la certificación? Mes y Año (9/2007)	Cuando fue la última vez que obtuvo la cerificación?	Porque dejó de ser certificado? (Código 7.10)
1									
2									
3									
4									

Código 7.10: Razones por dejar las normas o certificado
1 Altos costos
2 Por falta de precio premio
3 Precio premio demasiado bajo para cubrir los costos
4 Falta de apoyo
5 Discontinuidad en el apoyo
6 Dificultades en llevar los registros
7 Mucha carga de trabajo
8 Ya no lo necesitaba
9 Cambié de comprador y el nuevo comprador ya no preguntaba por un estándar
10 Cambié de producto/Dejé el producto
11 Mi finca es demasiada pequenha para ser rentable con un estándar
12 Por desintegración del grupo de productores
13 Por falta de comprados   14 Otro

Página 2 "Estandar 7"

7.21   Usted está pensando en adoptar una certificación o esta en el proceso de ser certificado? ___ (0=No; 1=Si)

Por No: Omitir sección
Por SI: Cual producto?   _____   Vea Código 7.03

7.22 *Si Usted está certificado, ha si cerificado alguna vez, está en proceso de certificación o considera certificación :* **Porque tiene o quiere obtener el certificado?**

Lea las opciones al productor y dejarlo decidir si aplica o no

Respuestas multiples	Si=1/No=0
1 El comprador está pidiendo/preguntando por el certificado. Indica Comprador	
2. Para aumentar la calidad de mi producto	
3 Por la alta cuota de rechazo de mi comprador	
4 Porque mi comprador me ofreció una garantía de compra con el certificado	
5 El comprador me ofreció un precio premio por el certificado	
6 Para aumentar mis ventas en mercados que valoran alta calidad con precio premio	
7 Por disminuir los costos de químicos	
8 Por mejorar mi reputación	
9 Para mejorar mi poder de negociación	
10 Porque encontrar un comprador es más fácil con un certificado	
11 Pienso que el manejo de la finca mejora y eso aumento mi rendimiento	
12 Porque el estándar esta bien para la salud de mi familia y mis trabajadores	
13 Porque queria aumentar mis conocimientos de uso de químicos	
14 Un familiar/un amigo me motivó de obtener la certificación	
15 Muchos otros productores del área están certificados	
16 Otros, específica	

Página 1 "Costos Estándar 8"

Sección 8 Costos de certificacion

OJO: Esta sección solamente si el encuestado esta, ha sido o esta en proceso de certifcación!!!costos a nivel inividual no en grupo

Por favor, compartenos informacion por todas las inversiones que tenia que hacer usted para poder realizar la certificación la primera vez!

		Costos únicos (solo se dan una vez)					
		8.01	8.02	8.03	8.04	8.05	8.06
ID	En cuales de las siguientes invirtió usted para obtener una certificación? (No aplica=99)	Monto total en Quetzales	Cual era el monto invertido por Usted?		Por si inivrtió: Usted usaba un crédito para pagar la inversión? No=0, Si=1	Por SI: de quién obtuvo el crédito? Código 1	Si el productor no cubrió todo los costos necesarios: Quien apoyaba con la inversión? Código 8.6
			Quetzales	Jornal			
1	Baño						
2	Ducha						
3	Almacén de quimicos						
4	Cazeta para recoleccionar envases						
5	Kit de primeros auxilios						
6	Equipo de protección						
7	Bomba de mochila						
8	Cubo para cosechar						
9	Facilidades para lavar manos						
10	Àrea para mezclar químicos/Fosa						
11	Señales y carteles						
12	Capacitaciones						
13	Minicentro de acopio						
14	Circulado para la parcela						
15	Inscripción en la SAT (Colaboración)						
16	Otro, esp.						
17	Otro, esp.						
18	Otro, esp.						

Código1: Prestamistas
1 Banco
2 Institución de Microfinanzas (Genesis empresarial etc.)
3 Cooperativa/Asociación/Grupo de Productores
4 ONG
5 Amigo, familiar
6 Prestamista informal
7 Comprador/Exportador
8 Otro

Código 8.6: Apoyo
1 = Organización Internacional
2 = Exportador
4 = Institución nacional
5 = ONG
6= Fundacion Agil
7= Grupo de Productores/Cooperativa
8= AGTEC
9 = Otro

Página 2 "Costos Estándar 8"

Por favor, comparenos información sobre los gastos que tiene que realizar usted cada cuanto para poder mantener la certificación!

ID	ITEM	Costos repetidos (anual)					
		8.07	8.08	8.09	8.10	8.11	8.12
		Monto total en Quetzales	Monto invertido por el productor		Usted usaba un crédito para pagar la inversión? No=0, Si=1	SI: de quién obtuvo el crédito? Código 1	Si el productor no cubrió todo los costos necesarios: Quien apoyaba con la inversión? Código 2
			Quetzales	Jornales			
1	Certificación y auditoría externa (Conrtibución)						
2	Capacitación anual						
3	Análisis de laboratorio						
4	Inspecciones internas y auditorias						
5	Operación del Sistema de calidad						
6	Transporte (productores a capacitación, asesoría, inspecciones, auditorias)						
7	Sustitución de equipo de protección						
8	Reposición para kit de primero auxilio (desinfectante, jabón)						
9	Chequeo de salud para trabajadores trabajando con pesticidas						
10	Formularios para los registros						
11	Señales y carteles de repuesto						
12	Cuota de membresía para grupo al anho						
13	Otro, esp.						
14	Otro, esp.						
15	Otro, esp.						
16	Otro, esp.						
17	Otro, esp.						
18	Otro, esp.						

8.13 En general: Si el comprador/exportador cubrió/cubre costos de certificación - lo descuenta del pago por producto entregado?
Si=1/No=0 _____

8.14 Por si: cuantos centavos descuenta por libra? _____

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Sección 9 Conocimientos financieras

Instrucción

Lea las preguntas al encuestado y no le indique si la respuesta es mala o buena, siempre motivarlo. Intentar hacer esta sección divertido, para que se siente entretenido el encuestado. No hacerlo sentir tonto. No inducir ni influir en la pregunta, si no lo sabe dejar la pregunta y insertar código 098

Ahorita vamos a distraemos un poquito y hacemos un pequeño juego.

9.01 Si! la probabilidad de enfermarse es de 10 %, cuantas personas de 100 podrían enfermarse?

_____

9.02 Cinco personas compraron el número ganador de la lotería Santa Lucía. El premio mayor es de 2,000 Quetzales. Del premio, cuanto le quedará a cada ganador?

_____

Si el entrevistado sabía por lo menos una respuesta, sigue. Si no, omita está sección.

| *Para las siguientes preguntas, entra el código 1 a 3, correspondiendo a la respuesta que da el entrevistado.*

9.03 Imagínese que Usted tendría 1000 Quetzales en una libreta de ahorro en el banco. Lo que gana el dinero son 2% al año (20 Quetzales en el primer año entonces). Después de cinco años, cuanto piensa Usted tendrá en su libreta de ahorro si no ha tocado el dinero?
1) Más que GTQ 1020   2) Exactamente GTQ 1C3) Menos que 1020 GTQ   1 Más

9.04 Imagínese si sus ingresos en el próximo año se hubieran duplicado. También todos los precios de los productos que consume su hogar duplicaron. En el año 2013 Usted podría comprar con sus ingresos
dia   2) Lo mismo que hoy   3) Menos que hoy en dia.   1) Más que hoy en   2 Lo mismo

9.05 Usted debe 3000 Quetzales en el banco con una tasa de interés de 1% cada mes. Si usted paga una cuota de 30 Quetzales cada mes. Cuantos años le llevara usted de eliminar su deuda?
1) Menos que 5 años   2) 5-10 años   3) Nunca (Usted continuará en deuda)   3 Nunca

9.06 Imagínese que usted obtiene un crédito de 1000 Quetzales en el banco. Cual de las siguientes opciones es mejor:
1) Pagar 5 % de interés cada mes   2) Pagar 24% de interés al año.   2 Opción 2

Información general sobre asuntos financieros

Ahorita cuentenos un poquito de dónde obtiene informaciones en questiones de dinero y créditos.

9.07	En general: de dónde obtiene informaciones en questiones de dinero? *Respuestas multiple, lea las possibilidades si el encuestado tiene dificultades*

	Si=1/No=0
1 Banco o Instituciones de microfinanzas	☐
2 ONGs	☐
3 Servicio de extensión	☐
4 Familiares y Amigos	☐
5 Otros, especificar	☐

9.08	Usted ha participado por lo menos una vez en una capacitación sobre temas de uso de créditos, ahorros, planificación

Si=1/No=0 _____

9.09	Quién ofreció esta capacitación?

Si:

	Si=1/No=0
1. Cooperativa, Grupo de Productores	☐
2. ONG	☐
3. Escuela de campesinos	☐
4. Donante internacional	☐
5. Exportador	☐
6. Otro: _____	☐

9.10	En cual año recibió usted la capacitación?

_____

Sección 10 Crédito
Instrucciones: Preguntar por créditos monetarios y en efectivo (Insumos, Electrodomésticos etc)

`10.01` Usted o algún miembro del hogar ha tenido algún crédito desde Junio 2011 hasta _____ (0=No; 1=Si)

respuesta si: Por favor danos información sobre los créditos que tiene el hogar actualmente o ha tenido desde el Junio 2011

Por si respuesta es no: seguir con pregunta 10.13

Credito ID	10.02 Prestamista (vea Codigo 10.02)	10.03 Beneficiario (vea codigo 10.03)	10.04 En que mes y año recibió el crédito? Ej. 9/2011	10.05 Cual es el monto total en Quetzales? — Créditos de insumos, bienes, electrodomesticos	Creditos monetarios	10.06 %	10.07 Cual es la tasa de interes por tiempo de pago? — Tiempo/Frecuencia de interes (Vea Codigo 10.08)	10.08 Para qué actividad principal uso el credito? (vea codigo 10.09)	10.09	10.10 Cuando fue el primer pago del credito? Ej. 9/2011	10.11 El prestamista provio asesoria financiera antes de darle el crédito? SI=1/NO=0	10.12 Cuales son las condiciones del crédito? Vea codigo 10.12
1												
2												
3												
4												
5												
6												
7												

Código 10.02: Prestamistas
1 Banco
2 Institución de Microfinanzas (Genesis empresarial etc.)
3 Cooperativa/Asociación/Grupo de Productores
4 ONG
5 Amigo, familiar
6 Prestamista informal
7 Comprador/Exportador
8 Otro

Código 10.03: de beneficiario:
1 Jefe
2 Esposo/esposa
3 Hijo/hija
4 Padre/madre
9 Cuñado/cuñada
10 Otro familiar
11 Otro no familiar

Código 10.08: Tiempo
1 Semanal
2 Quincenal
3 Mensual
4 Anual

Código 10.09: Uso
1. Inversion relacionada a certificacion de un producto agricola
2 invertirlo en negocios o actividades agropecuarios
3 invertirlo en actividades no agropecuarias
3 gastos en emergencia o enfermedad
4 pago de deudas del hogar
5 conctruccion o mejoras de vivienda
6 compra de alimentos
7 Estudios de un familiar
8 otro, cual?

Código 10.12: condiciones
0 Ninguno
1 Fiador
2 Constancia de ingreso
3 titulo de propiedad
4 Otro, esp.

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10.13 Usted ha encontrado alguna vez problemas en obtener un crédito? _____ (0=No; 1=Sí)

Si: Por favor indica porqué

NO: omitir pregunta y seguir con siguiente

1. No tengo los ingresos suficientes ☐	5. Mala referencia ☐
2. No puedo dar ninguna garantía ☐	6. Falta de documentos ☐
3. Yo no sé dónde obtener un crédito ☐	7. Edad ☐
4. Nunca lo intenté ☐	8. Otros, esp. ☐

10.14 Usted ha tenido alguna vez problemas en pagar un crédito? _____ (0=No; 1=Sí)

Por Sí: Por favor indica cuales problemas

Por NO: omitir pregunta y seguir con siguiente

Si=1/No=0

1. Disminución imprevista en los ingresos agrícolas	☐
2. Disminución imprevista en los ingresos no-agrícolas	☐
3. Aumento imprevisto de la tasa de interés	☐
4. Evento imprevisto como accidente, enfermedad o muerte de un familiar	☐
5. Otro, indica	☐

10.15 Usted o algún otro miembro de su hogar tiene actualmente ahorros? _____ (0=No; 1=Sí)

Por Sí: por favor proveenos información.

Por NO: omitir pregunta

	10.16	10.17	10.18
Ahorro ID	Código de Miembro	Monto (Código 1)	Dónde tiene sus ahorros? (Código 2)
1			
2			
3			
4			
5			
6			

Código 1	Código 2
1 Q 0 – 500	1 Banco
2 Q 501 – 1000	2 Institución microfinanciera
3 Q 1001 – 1500	3 Cooperativa
4 Q 1501 – 2000	4 Grupo de ahorro
5 Q 2001 – 2500	5 Casa
6 Q 2501 – 3000	99 Otro, especificar
7 Q 3001 o más	
No contestar	

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Sección 10 Acceso a crédito 2   *Solamente si encuestado y su familia no tienen ningun crédito*

11.01 Usted podria obtener un crédito monetario o no-monetario (Insumos, bienes etc) si lo necesitaria para uso agricola? ____ (0=No; 1=Si)

Por SI   **Por NO: omitir pregunta y seguir con la siguiente**

11.02 Con que institucion podria obtener el crédito?

Respuestas multiples   Si=1/No=0

		Si=1/No=0
1 Banco		☐
2 Institucion de Microfinanzas		☐
3 Cooperativa/Asociación/Grupo de Productores		☐
4 ONG		☐
5 Amigo, familiar		☐
6 Prestamista informal		☐
7 Comprador/Exportador		☐
8 Otro		☐

Seguir con próxima seccion

11.03 Cuales son las razones por las que usted no podria obtener un crédito?

	Si=1/No=0			Si=1/No=0
1. No tengo los ingresos suficiente	☐	4. Mala referencia		☐
2. No puedo dar ninguna garantia	☐	5. Falta de documentos		☐
3. Yo no sé dónde obtener un crédito	☐	6. Otro, especifica		☐

Sección 12 Comercialización

Por favor, cuénteme de la comercialización de la arveja de Junio 2011 a Julio 2012

Instrucciones: Preguntar por las relaciones con **cada** *comprador*

12.01	Usted comercializa su producto individualmente o en grupo? 1 individual ☐ 2 grupo ☐
12.02	Usted entrega su producto a un centro de acopio? Si=1/No=0 ☐
12.03	El comprador trae el producto desde su casa/parcela? Si=1/No=0 ☐
12.04	Usted empaqua el producto antes de entregarlo a su comprador? Si=1/No=0 ☐

Por favor cuénteme de sus relaciones comerciales e informaciones de cada de sus compradores de la arveja. Empieza con el comprador que es el más importante para usted.

ID Code	12.05	12.06	12.07	12.08	12.09	12.10	12.11	12.12	12.13	12.14	12.15	12.16	12.17	12.18	12.19
Nombre (no va codificado)	Comprador (Código 1)	Dulce=1; Grano=2; China=3	Desde cuando está trabajando con este comprador? Ej: 9/2000	Cuantos quintales le entrega normalmente al comprador por temporada?	Cual es el precio promedio que recibe del comprador por quintal en el año pasado? En Quetzales	Cual es el Precio más bajo por quintal en Quetzales que recibieron en el año pasado	Precio más alto por Quintal en Quetzales? Hacer conversión	Cual es el ingreso promedio en la primera cosecha que recibe de este comprador en Quetzales?	Cual es el ingreso promedio en la segunda cosecha que recibe de este comprador por entregar? % (No aplica= 099)	Cual es el rechazo primordial por rechazo? (Código 2)	El comprador devuelve el rechazo? No=0/Si=1	Por si: Vende el rechazo? No=0/Si=1	**Usted puede negociar el precio con este comprador? (No=0;Si=1)**	**Alguna vez ha prestado dinero o ha adquirido insumos de este comprador? (No=0;Si=1)**
1															
2															
3															
4															
5															

Código 1: Comprador: (Deje que el encuestado responda y elija la clasificación. Si es necesario, lea las opciones en voz alta. Si el encuestado vende a dos (o más) diferentes compradores en la misma categoría, repita el código las veces necesarias)

1 = Intermediario/Coyote (en general)	5 = Intermediario/ Agente comercial que lo vende a una exportadora, especifica exportadoras 8 = Otro, especificar
2 = Cooperativa, especifica	6= Directamente a la empresa exportadora/empaquadora, esp.
3 = mercado al por mayor, especifica	
4 = Supermercado/detallista, especifica	7 = Productor lo vende independientemente en el mer...

Código 2: Rechazo

1 Problemas de calidad: color

2 Problemas de calidad: forma

3 Problemas de calidad: tamaño

4 Demasiada oferta (comprador no puede acopiar todo)

5 Otras no especificadas

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12.20	12.21	12.22	12.23	12.24	12.25	12.26
Comprador (orden de tabla anterior)	Cuantas veces le visitó su comprador en el año pasado? Nunca=0	El comprador que le provee algunos insumos? (Vea código 3)	Usted conoce los requisitos de calidad que esta usando su comprador en evaluar el producto?(No=0,Si=1)	A que destino o país vende comprador el producto? Código 4	Cual es la política de pago de este comprador? (Código de pago)	Qué tipo de contrato tiene Usted con su comprador? (Código 6)
1						
2						
3						
4						
5						

Código 3: Insumos

0 No recibo ningunos insumos de mi comprador
1 Recibo químicos
2 Recibo fertilizantes
3 Recibo semillas
4 Otros, especifica

Código 4: Mercado

1 Local
2 Nacional
3 Internacion0 NO SE
4 EE.UU.
5 Europa
6 Centroamerica
7 Otro, esp

Código 5: Pago (Lea las opciones y deja escoger al productor)

1 Pago completo en efectivo antes/ durante la cosecha
2 Pago completo en efectivo con la entrega del producto
3 Pago completo después de la entrega de producto. Por favor indica cuanto tiempo después. _____
4 Pago cada ___ días
5 Pago cada ___ semanas
6 Pago en efectivo en varias cuotas
7 Pago completo en especie
8 Otro, especificar

Código 6: Acuerdo

0 **No hay acuerdo fijo**: significa que comprador y productor no tienen ningun acuerdo sobre detalles como calidad, precio, cantidad etc. antes de que se efectúe el intercambio. (Mercado al contado)
1 **Acuerdo oral**: Comprador y productor acordaron oralmente sobre detalles como calidad, precio, cantidad, etc. antes de que se efectúe el intercambio.
2 **Acuerdo escrito**: Comprador y productor acordaron en un contrato escrito sobre detalles como calidad, precio, cantidad etc. antes de que se efectúe el intercambio.

Página 1 "Contrato 13"

Sección 13: Contratos de Comercialización
Solamente si el productor tiene por lo menos un acuerdo escrito o oral

Por favor, cuenteme del contenido del acuerdo con
su comprador **más importante de arveja**

13.01	Cuando se hace el acuerdo?	1 Antes de la siembra
		2 Antes de la cosecha
		3 Después de la cosecha, antes de la entrega

13.02	Cual es el marco de tiempo del acu	1 Una temporada
		2 Un año
		3 Más de un año
		4 No es definido
		5 Otro, espécificar

Leer al encuestado y dejarlo decidir que aplica

	Sobre que puntos usted y su comprador se pusieron de acuerdo? (respuestas multiples)	No=0/ Si=1
13.03	Sobre los requerimientos de calidad para el producto (Estándares, norma)	
13.04	sobre la entidad encargada del control de calidad	
13.05	sobre el rechazo promedio	
13.06	Sobre la política del uso del rechazo	
13.07	sobre el tiempo de entrega del producto (ej. cada dia, semanal, quincenal)	
13.08	sobre la forma como cultivar el producto	
13.09	sobre un precio fijo u otros mecanismos para determinar el precio (Precio garantía)	
13.10	sobre el empaque y transporte del producto	
13.11	sobre la política de pago	
13.12	sobre asistencia técnica	
13.13	sobre políticas en caso el comprador o el productor no puede cumplir con el acuerdo	
13.14	sobre mecanimos de seguro en caso de daños al cultivo	
13.15	sobre como usar los insumos (p.ej: cantidad de fertilizantes, pesticidas)	
13.16	sobre los insumos que provee el comprador	
13.17	sobre opciones de crédito en caso de problemas financieras	
13.18	Sobre la política en caso de perdidas o robos de producto	

Página 1 "Riesgo I 14"

Sección 14 Riesgos I
Instrucciones: *Preguntar por cada riesgo. Trabajar con el cuadro de barras y dejar escoger siempre al encuestado la barra correspondiente*

ID	Por favor compartenos su opinion en cuanto a los siguientes riesgos	En su opinión: qué tan probable es que ocurre este riesgo? *Insertar número correspondiente de la tabla de barras*	Por si pasara este riesgo - que tanto le afetcaria a usted en su negocio agricola? *Insertar número de la tabla de barras*
14.01	Aumento de la inseguridad ciudadana		
14.02	Discontinuidad en el soporte por Instituciones nacionales e internacionales		
14.03	Aumento en la inseguridad de títulos de tierra		
14.04	Deterioro de la infraestrctura pública (vial, salud, educación, justicia)		
14.05	Inestabilidad de precios de venta (disminución, volatilidad)		
14.06	Dificultades en la comercialización (*Normas del comprador, acceso a mercado, infraestructura de comercialización, comprador no compra etc.*)		
14.07	Aumento de precios por la renta de tierra		
14.08	Aumento en los precios de insumos agrícolas (fertilizante, etc)		
14.09	Ataque severo de plagas y enfermedades		
14.10	Ausencia imprevisto de un miembro importante		
14.11	Sequia		
14.12	Exceso de lluvia/hurracan/inundaciones		
14.13	Erosión		
14.14	Reducción de la fertilidad de los suelos		
14.15	Heladas		
14.16	Falta de mano de obra para contratar		
14.17	Problemas de liquidez/falta de efectivo		
14.18	Dificil acceso a crédito		
14.19	Miembro familiar pierde importante fuente de ingresos no-agrícola		
14.20	Incapacidad de hacer una inversión necesaria para quedarse en el mercado (i.e. sistema de riegos etc)		

14.22	*Instruccion: El encuestado tiene que indicar de una escala de 0 a 10 que tanto le gusta el riesgo. 0: no me gusta por nada el riesgo, 10: A mi me encanta el riesgo! No preguntar por los porcentajes*

Por favor indica si usted se considera una persona que le gusta tomar riesgos o evita tomar riesgos

Evito | | | | | | | | | A mi me gusta mucho tomar riesgos

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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Página 1 "Riesgo II 15"

ID	Seccion 15 Actitud de riesgo II *Preguntar y trabajar con la tabla de caritas. Según su opinión el encuestado debe escoger una carita. OJO: se trata de declaraciones, NO son preguntas!!!El encuestado nos tiene que decir su opinión: está de acuerdo con la afirmacion o no!!!*	Numero
	Actitudes	
15.01	En la comercilización agrícola es mejor tener seguridad financiera que inseguridad financiera.	
15.02	Usted siempre es uno de los primeros productores del área de probar una nueva tecnología (nueva variedad, sistema de riego etc)	
15.03	Es bueno tomar riesgos con un negocio agrícola (invertir, jugar con los precios etc.)	
15.04	Usted accepta más riesgo en su negocio agrícola en comparación con otros productores	
15.05	Con respeto a un negocio agrícola, no es bueno tomar riesgos (reverse)	
15.06	Es bueno tomar riesgos financieros altos para poder realizar una ganancia más alta.	
15.07	Es bueno vivir hoy y no preocuparse por el día de maniana	
15.08	Es mejor gastar el dinero en vez de ahorrarlo. (Prefiero comprar un celular nuevo en vez de ahorrar el dinerito)	
15.09	Usted paga sus deudas a tiempo	
15.10	(Reversed) No es bueno confiar en informaciones de mercado en la toma de decisiones.	
15.11	(Reversed) Antes de hacer una compra especial para la finca hay que contralar las finanzas del hogar.	
15.12	(reversed) No es importante para una finca trabajar en ganado.	
15.13	Ingresos de negocios no-agrícolas NO son importantes para la economía familiar	
15.14	Tener las parcelas en una misma zona aumenta el riesgo en los cultivos	
15.15	En el caso de una emergencia familar es muy dificil mantener la producción.	
15.16	Cuando un productor está enfermo no hay quien hace su trabajo.	
15.17	(reversed) Si fuera disponible, sería bueno tener un seguro agrícola.	
15.18	Nunca hay suficiente efectivo para pagar facturas y deudas. (reversed)	
15.19	Usted ahorra parte de sus ingresos	
15.20	El funcionamiento del equipo agrícola no se examina regularmente.	
15.21	Es recomendable siempre controlar sus cuentas.	

Sección 17 Percepciones de cambio

SOLAMENTE si entrevistado ha adoptado algun estandar/Está certificado. Si no es certificado, seguir con 17,14!

ID	Declaración	Numero según carita escogida
17.01	Desde que tiene el certificado es capaz de producir productos de alta calidad	
17.02	Desde que tiene el certificado su comprador rechaza menos producto	
17.03	No siente ningun cambio en su negocio agricola desde que tiene el certificado (reversed)	
17.04	Su reputación como un buen productor de vegetales ha mejorado desde que tiene el certificado	
17.05	Desde que tiene el certificado su comprador esta invirtiendo mas en su relación comercial	
17.06	Desde que tiene el certificado confia mas en su comprador	
17.07	No siente ningun cambio en la relación con su comprador desde que tengo el certificado (reversed)	
17.08	Desde que tiene el certificado siempre vende a su comprador, aunque otros le hagán mejores ofertas	
17.09	Desde que tiene el certificado la relación con su comprador ha mejorado	
17.10	Desde que tiene el certificado su comprador está mas dispuesto a apoyarle cuando tiene problemas (plagas, problemas financieras	
17.11	Desde que tiene el certificado no siente ningun cambio en sus ingresos agrícolas (inverso)	
17.12	Desde que tiene la certificación esta gastando menos en plaguicidas, insecticidas y otros insumos quimicos	
17.13	Desde que tiene el certificado tiene más estabilidad economica	

17.14 En general: Como se siente con la situación actual de su negocio agricola?

1	2	3	4	5	6	7

17.15 En general: como se siente con respeto al futuro de su negocio agricola?

1	2	3	4	5	6	7

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Sección 16 Confianza y dependencias de poder

Piense en su comprador de arveja mas importante: Como es su relación con el?

Instruccion: Lea la declaración y pregunta su opinion según la escala

ID	Declaración: Trabajar con las caritas	Según opinion insertar código de caritas
16.01	La información que le provee su comprador siempre es correcta	
16.02	(Reverse) Para usted es difícil cooperar con su comprador	
16.03	(Reverse) A veces su comprador es poco fiable	
16.04	Cuando se trata de cosas que son importante para su negocio agrícola, usted puede contar con su comprador	
16.05	Siente que su comprador este interesado en una relación a largo plazo	
16.06	Su comprador siempre compra la cantidad que acordaron antes	
16.07	Si tiene problemas financieras por una enfermedad o pérdidas de cosecha su comprador le apoya	
16.08	Usted esta libre de escoger a su comprador en cualquier momento	
16.09	(reverse) Si su comprador no es fiable con lo que acordaron, usted busca un nuevo socio comercial	
16.10	Aunque haya un mejor precio en el mercado usted esta obligado a vender a su comprador	
16.11	Aunque haya un mejor precio en el mercado usted quiere vender a su comprador	
16.12	(reverse) Si hubiera un mejor precio en el mercado al que le ofrece su comprador usted esta interesado en vender en el mercado	
16.13	Su comprador tiene todo la información comercial que necesita	
16.14	Tiene que cumplir con las demandas de su comprador, aunque no es confiable	
16.15	Usted conosco otros compradores que comprarán su producto inmediatamente	
16.16	Como su comprador podría comprar el producto de otro productor, mejor hace todo lo que le demanda	
16.17	Su comprador es capaz de engañar en relaciones comerciales	
16.18	Hasta donde usted sebe, su comprador nunca ha engañado a un productor en relaciones comerciales	
16.19	**En general: Que tan satisfecho esta usted con la relación comercial con su comprador (más importante)**	

1	2	3	4	5	6	7
☺	☺	☺	☺	☺	☺	☺

ID:_____

Sección 18 Indicadores de acceso

Organización

18.01 Usted es actualmente miembro de algun grupo o alguna asociación? ___ *(0=No; 1=Si)*

Si: de que tipo de grupo se trata?
Lea

No: ir a 18.06

Qué tipo de beneficios recibe Usted de este grupo(s)?

	18.02	18.03	18.04
	Tipo de grupo	0=No; 1=Si	Desde cuando es miembro de la organización (ej. 2003)
1	Grupo de productores/Asociacion		
2	Cooperativa agricola		
3	Iglesia		
4	Grupo de mujeres		
5	Grupo comunitario		
6	Otro (especificar)_____		

	18.05	
	Tipo de servicio	0=No; 1=Si
1	Servicio de crédito	
2	Acceso a insumos	
3	Capacitaciones en producción	
4	Capacitaciones en comercialización	
5	Comercializacion de productos	
6	Red de ayuda social	
7	Centro de acopio	
8	Otro, esp.	

Infraestructura e Instituciones
Por favor indique si las siguientes facilidades están disponibles en su aldea/dónde vive y indique si usted tiene acceso o no.

ID	Facilidad	18.06 Disponible dónde reside? 0=No; 1=Si	18.07 Tiene su hogar acceso a dicha facilidad? 0=No; 1=Si	18.08 Por si no esta disponible: Distancia al más próximo en minutos	18.09 Tipo de transporte que usa normalmente
1	Electricidad				
2	Agua potable				
3	Banco				
4	Agente de tigo money				
5	Administración municipal/departamental				
6	Carretera principal asfaltada				
7	Policia				
8	Transporte público				
9	Centro de salud				
10	supermercado				
11	Mercado local				
12	Comprador de vegetales no-tradicionales				
13	Plaza dónde puede vender hortalizas				
14	Medio de transporte para flete				
15	Agente de remesas				
16	Agente bancario autorizado				

Código 4: Transporte	
1 a pie	5 Caballo
2 Moto	6 Bicicleta
3 Carro	5 otro, esp.
4 Transporte público (bus, tuctuc)	

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Página 2" 18 Indicadores de Acceso"

ID:_____

18.10 Usted tiene acceso a servicio de asesoría agrícola? ___ *(0=No; 1=Si)*

SI: que tipo de servicio proveen y con què frecuencia?   No: omitir pregunta

Proveedor de servicios	18.11 Cual tipo de información proveen? Còdigo de Informacion	18.12 Cuantas veces se reunian en el último año?
1. Institución pública (MAGA etc)		
2. Sector privado (Agexport, Exportadora etc)		
3. Universidad		
4. Grupo de productores/cooperativa		
5. ONG		
6. Donante internacional		
7. Otros, especificar		

Código de Información
1 Info sobre técnicas de producción
2 Info sobre Mercado, Precio, Comercialización
3 Info sobre normas y BPAs
4 Otro, esp.

Acceso a información

18.13 Usted usa el internet?   ___ (0=No; 1=Si)   *NO: omitir pregunta 18.14*

18.14 Por Si: para que fines usa el internet?

1	Para contactar compradores	☐
2	Para contactar extensionistas	☐
3	Para obtener informaciones de mercados	☐
4	Para banca electrónica y pagos en línea	☐
5	Otros, especifica	☐

18.15 Usted dispone de un celular? ___ (0=No; 1=Si)   *NO: omitir pregunta 18.16*

18.16 Por Si: desde cuando dispone de un celular?   ___ Año

18.17 Para que fin usa el celular?   Si=1/No=0

1	Para contactar combradores	☐
2	Para contactar extensionistas	☐
3	Para buscar informaciones sobre mercado, precio, cor	☐
4	Para banca electrónica y pagos	☐
5	Otros, especificar	☐

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Appendix 2 Declaration on the proportion of own work performed

I, hereby, declare the proportion of own work performed in the scientific papers, which are included in this dissertation.

Paper 1 Clusters and Global Value Chains: conceptual approaches and case-study evidence of the agri-food sector

The paper is a joint work with Nico Herforth. I contributed to the paper with the Chapter 2.2 „Global Value Chains – a conceptual approximation" and Chapter 5.2 „The snow pea export sector in Guatemala", including literature review. The design of the paper, the revision as well as the Introduction and Conclusion are joint work with Nico Herforth.

Paper 2: Supply Chains of Non-traditional Export Products between Latin America and Europe: The Role of Private Certification Standards

The paper is a joint work with Prof. Dr. Ludwig Theuvsen and Verena Otter. I contributed to the paper with the chapter 5 „Certification-based Food Safety Standards: Their Role in and Impact on Developing and Emerging Countries". This included literature review and writing of the paper.

Paper 3: Food safety standards in the Guatemalan fresh pea sector: The role of financial literacy in technology adoption

This paper is co-authored by Prof. Dr. Ludwig Theuvsen. I was responsible for the complete research project from conceptualizing the research idea, design of the survey, data collection and entry as well as data analysis, interpretation of the results and writing of the paper. Prof. Dr. Ludwig Theuvsen was involved as a scientific advisor at all stages of the research project.

Paper 4: Financial literacy and food safety standards in Guatemala: the heterogeneous impact of GlobalGAP

This paper is co-authored by Prof. Dr. Ludwig Theuvsen. I was responsible for the complete research project from conceptualizing the research idea, design of the survey,

data collection and entry as well as data analysis, interpretation of the results and writing of the paper. Prof. Dr. Ludwig Theuvsen was involved as a scientific advisor at all stages of the research project.

Appendix 3: Curriculum Vitae

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<u>Ausbildung</u>

4/11 – 2/15	Georg-August-Universität Göttingen, Doktorin der Agrarwissenschaften, Doktorarbeit: Food safety standards in developing countries: Exploring the role of financial literacy (Note 1,0), Betreuer Prof. Dr. Ludwig Theuvsen.
4/02 - 4/09	Universität Köln, Diplom-Regionalwissenschaften Lateinamerika Volkwirtschaftslehre, Wirtschaftsgeographie, Lateinamerikanische Geschichte. Diplomarbeit: Global Chain Governance und Standards: Der Fall Chiquita (Note 1,0).
8/03 - 3/04	Universidad Europea de Madrid, Spanien.

<u>Arbeitserfahrung</u>

Seit 4/11	Georg-August-Universität Göttingen, wissenschaftliche Mitarbeiterin. *DFG-Graduiertenkolleg "Transformation of the Global Agri-Food System: Trends, Driving Forces and Implications for Developing Countries".*
10/09 – 12/10	Deutscher Entwicklungsdienst (ded / GIZ), Guatemala, Juniorberaterin

6/08	triple innova, Wuppertal, Forschungsassistentin (Praktikum)
08/07 – 01/08	Fundación ProPetén, Flores, Guatemala, Beraterin (Praktikum)
2/07 – 6/07	connosco e.V., Köln, Projektmanagerin (Praktikum)