Quality Improvement in African Food Supply Chains: Determinants of Farmer Performance

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Quality Upgrading in Barley Value Chain in Ethiopia: Determinants of Smallholder Performance

Abstract

The integration of smallholders in modern value chains in sub-Saharan Africa (SSA) is an important pathway for improving income and farmer livelihoods. Connected to demographic shifts, rapid urbanization, and the emergence of a middle-class, there is a demand for higher product quality. In order to access these modern markets, smallholders need to enhance the quality of their products. However, factors that determine smallholders' decision to invest in quality upgrading are not well understood. Using cross-sectional data from the Ethiopian barley sector, we analyse the factors that explain smallholders' decision to improve quality. We find that socioeconomic, institutional and market factors affect the decision to improve quality. Our study contributes to the understanding of the determinants of quality upgrading at micro level, of the economics of quality production, and thus of rural development.

Key words: Quality-upgrading, economics of quality, institutional arrangement, smallholders, malt barley, Ethiopia

1. Introduction

In most SSA countries, smallholder agriculture is an important driver of food security, rural employment, and reducing poverty. In Ethiopia, for instance, more than three-quarters of the population is employed in smallholder agriculture and about 40% of the GDP is derived from this sector (FDRE, 2016). However, food insecurity and malnutrition are still prevalent in rural areas, where most of the population rely on low-productivity semi-subsistence farming. In recent decades, SSA food systems have changed due to rising incomes, urbanization, and globalization (Jayne et al., 2010; McCullough et al., 2008; Minten et al., 2016; Tschirley et al., 2015). These changes affect both export supply chains and domestic food chains (Haggblade, 2011). Smallholders are increasingly integrated in these chains, which means they purchase more and other inputs, they change their cultivation methods, and they sell a larger share of their production. Value chain integration is often seen as a pathway to increase food security and improve smallholders' livelihood (Bolwig et al., 2010; Kilelu et al., 2017; Kissoly et al., 2017).

Many studies have explored the integration of smallholders in food value chains and have evaluated the impact on farm productivity and farmer welfare (Barrett, 2008; Barrett et al., 2012; Minten et al., 2016; Kissoly et al., 2017). In addition, quite a few studies have explored conditions for smallholder compliance with quality standards particularly in the export value chains. Compliance with standards often requires considerable human, physical, financial, and network resources (Lemeilleur, 2013). Other studies argue that standards can be a catalyst for improving farming techniques and product quality, thereby allowing farmers to participate in high-value markets. While export chains for horticultural products have been the main focus of these studies, not much attention has been given to (quality issues in) the staple food value chains (Maertens and Vande Velde, 2017*)*. Driven by the emergence of a middle-class and by changes in consumption patterns, the demand for processed and higher quality foods is on the rise also in domestic food value chains (Tschirley et al., 2015; Reardon et al., 2009). This demand offers both opportunities and challenges for smallholders (Swinnen, 2016).

Producing better quality products often involves taking risk and making investments, which could be challenging for resource-poor farmers. Producing quality products for demanding markets requires adoption of new standards and exerting more effort (thus cost) in producing, harvesting, sorting, storing, packaging, and marketing. Complying to higher quality requirements is challenging for smallholders given their lack of appropriate and sufficient farm resources and farmer capabilities (Poulton et al., 2010). To overcome these

challenges and link smallholders to demanding markets, three types of institutional arrangements are often suggested, including Producer Organizations (World Bank, 2008), Contract Farming Arrangements (Barrett et al., 2012) and Partnerships (Narrod et al., 2009). Participation in these institutional arrangements can help farmers to improve product quality by facilitating access to inputs, credit and extension services (Royer et al., 2016).

Our study uses a micro-perspective in exploring the determinants of the farmer decision to engage in quality improvement activities. This paper contributes towards filling an empirical and theoretical gap in economic development literature through employing an econometric model and developing a conceptual framework to investigate the factors influencing quality improvement by smallholders.

Our approach is based on a case study of a domestic grain value chain, the Ethiopian barley chain. Driven by the fast growing brewery industry in Ethiopia, the barley value chain is undergoing fundamental changes (Rashid et al., 2015; Tefera et al., 2019). Several multinational brewers entered the Ethiopian market and started sourcing malt barley directly from smallholders. The production of barley with good malting quality is of critical importance to the brewery industry. Previous studies on the barley sector focused on exploring trade arrangements, value chain structures, and actors' collaboration (Alemu et al., 2015; Watabaji et al., 2016). To our knowledge, no study has systematically explored the factors that affect smallholder performance in improving quality at micro level. Therefore, the main objective of this study is to better understand how smallholders manage quality improvement in malt barley value chains.

The paper is organized as follows. Based on a review of economics and development literature, section 2 provides the analytical framework of the study. Section 3 presents an overview of the emerging Ethiopian barley sector. Section 4 describes data and methods including econometric strategy. Section 5 presents empirical results. Section 6 discusses the findings and section 7 concludes.

2. Analytical framework

Quality and safety are becoming increasingly important in the management and marketing of food products. In a dynamic market environment, quality attributes of a product are a critical element in competition (Bowbrick, 2014). Quality is a complex concept, the meaning of which may vary for specific products and between individuals, regions and countries. Thus, quality may have a different interpretation for different

value chain actors (Van Tilburg et al., 2007). For producers the main quality attributes include crop yield and disease resistance, for processors it is the uniformity of the raw material, for the wholesaler it is shelf life and availability, and for consumers it is healthiness, taste and convenience. Improving product quality involves costs for producers, particularly in cultivation, harvesting, sorting and packaging (Mujawamariya et al., 2012). Farmers will only accept these cost if there is a good chance their revenues more than offset the additional (marginal) costs.

Malt barley is a speciality product with both intrinsic and extrinsic quality attributes. Intrinsic malt barley quality is associated with the physical properties consisting of grain size, colour, appearance, moisture content, and protein content. These attributes can be managed and improved through good crop management, proper harvesting and post-harvest handling. Extrinsic quality of malt barley includes the use of pesticides in cultivation. In the brewery industry, the intrinsic quality attributes of malt barley are highly relevant and are usually measured in malt barley transactions.

At micro level, the decision of the smallholder to engage in quality improvement can be determined by several factors. Focusing on farm operational management, Royer and Bijman (2012) identified six factors that influence the decision to improve product quality. These include (a) agronomic techniques currently used by the farmer; (b) access to inputs; (c) availability of market information; (d) extent of expected transaction costs; (e) quality of the physical infrastructure; and (f) availability of independent services for measuring the quality. Mujawamariya et al. (2012) indicated that harvest and post-harvest practices, environmental factors and market factors (such as a price incentive) determine the supply of quality gum arabic by local collectors in Senegal. On top of these factors, participation in producer organizations and contract farming arrangements, farmers' socioeconomic characteristics, and the presence of specific buyers could influence the smallholder decision to improve product quality.

The factors that influence smallholder decisions consist of farm/farmer characteristics, supply side factors, and demand side factors (Figure 1). Socioeconomic characteristics such as age, innovativeness, education and entrepreneurial attitude of the household head, and available farm resources, all enable smallholders' capacity and capability to improve quality. Knowledge and experience play a key role in farmers' decisions to adopt innovation and to interpret information related to quality requirements (Meijer et al., 2015). Farmers' education and knowledge affect technology adoption and implementation of farm management practices that could improve productivity and quality (Kersting and Wollni, 2012).

Supply side factors are factors that enable the farmer to engage in quality improvement. These factors include access to farm inputs and the availability of support services. To improve product quality, access to and utilization of modern inputs greatly matter. For instance, adoption of improved varieties, fertilizers and pesticides increased wheat productivity and quality in Ethiopia (Shiferaw et al., 2014). Access to services such as credit, extension, and training help farmers to use new varieties and apply new cultivation techniques. For example, credit from cooperatives, traders and agro-dealers is used to smooth-out farmers' capital constraint in purchasing the necessary inputs (Olomola, 2014).

Demand side factors include price premiums for higher quality products and information about demand. The price offered to the farmer should not only cover higher production costs, but also the higher transaction costs related to producing and selling higher-quality products (Jaffee et al., 2011). Given the higher risks involved in producing and selling higher quality products, obtaining detailed information on the demanded quantity and quality has become more important for farmers to make the proper decision. Additional demand side factors may be low transaction risk, good infrastructure and the presence of independent quality control agencies.

Farmers can obtain access to the necessary inputs and credit (supply side) and to remunerative markets through several pathways. Institutional arrangements such as contract farming arrangements (CFAs) and producer organizations (POs) are often used to reduce transaction costs, provide access to inputs and credit, and remedy the lack of coordination between smallholders and buyers (Poulton et al., 2010; World Bank, 2008). They often facilitate the availability of market information for farmers and reduce market risks. These institutional arrangements are also important on the supply side, by giving farmers' access to modern inputs and services. Many studies have shown that POs provide services that are critical for enhancing farmers' capacities to meet the quality demands of high-value markets (e.g., Fischer and Qaim, 2012, 2014; Latynskiy and Berger, 2016; Shiferaw et al., 2011; Trebbin and Hassler, 2012). POs do this by (a) facilitating information flows and reducing transaction costs; (b) giving technical assistance and collective purchasing of modern inputs; and (c) providing storage and transportation services.

A rapidly growing literature portrays CFAs as an innovative approach to link smallholders to modern markets through facilitating access to modern inputs, credit, and specialized training (for reviews, see Bellemare and Bloem, 2018; Ton et al., 2018; Otsuka et al., 2016). Contracts provide the necessary coordination between buyers and sellers, while as part of the CFA, farmers obtain access to credit, modern inputs, extension and

advisory services, and quality control services. The effectiveness of CFAs depends on product characteristics and institutional environment.

Based on this brief review of the literature, summarized in our conceptual model (Figure 1), we developed a number of research questions that guide the empirical investigation of the factors influencing smallholder performance in improving barley quality. First, what farm and farmer characteristics affect smallholder performance in improving malt barley quality? Second, what supply side factors allow farmers to invest in barley quality improvement? Here we particularly look at the availability of improved seed varieties. Third, what is the impact of membership in a PO or participation in a CFA on the likelihood of improving malt barley quality? The assumption behind the latter question is that POs and CFAs are the organizational mechanisms through with farmers are affected by demand side factors like higher prices and reduced transaction costs.

3. The Ethiopian barley sector – An overview

Barley is among the top five important cereal grains in Ethiopia (CSA, 2015). Two types of barley exist: food barley (food purpose) and malt barley (brewing beer). The Arsi highlands of Oromia are the main production area of malt barley (ATA, 2016) and the Assela Malt Factory (AMF), located in this area, is the largest malt barley processing plant in the country. The value chain of barley –> malt –> beer consists of input supply, production, trading, processing, retailing, and consumption (Tefera et al., 2016b). Driven by a fast growing beer market, the demand for malt barley has increased over the last decade, leading to a restructuring of the malt barley value chain. Two types of chain structures are identified: conventional and modern. Figure 2 shows the structure of these two chains.

In the modern chain, international brewers like Heineken (Netherlands) and Diageo (UK) are using vertical coordination mechanisms in their supply chains. POs are the main suppliers to the companies and play intermediary roles including contract negotiation, product aggregation, and transportation (Alemu et al., 2015). CFAs are used to safeguard the vertical coordination between the companies and smallholders (Tefera et al., 2016b). As part of their supply chain strategies, brewers have made contractual agreements with farmers or their POs about providing improved seeds, fertilizers and pesticides on pre-financing basis. They also hired NGOs and consultants to provide technical assistance and training, often through newly established farmer groups.

In the conventional chain, Assela Malt Factory (AMF) is the dominant buyer of malt barley from traders through spot market transactions. The conventional chain is characterized by a limited involvement of POs, dominance of traders, and the participation of many local collectors and brokers (Figure 2). AMF has been facing problems about the quality (e.g., impurity & varietal mix) of the malt barley collected from traders (Watabaji et al., 2016).

Malting is a biological process that transforms barley into malt, the key ingredient in beer making (Oser, 2015). It is a three-step process consisting of steeping (soaking the barley grains into water), germination, and kilning (drying the final malt). Malt quality essentially depends on the quality of barley grains. Thus, barley must meet strict quality criteria to be acceptable for malt production and indirectly for beer production. The main attributes of high quality malting barley are high germination rate (>95%), good grain size, natural colour, low moisture content (<13.5%) and low protein content (9-11.5%)(Kumar et al., 2013; Oser, 2015).

We observed in the field that the quality standards used by AMF are the industry standards. However, brewers used their own private standards in purchasing malt barley through the modern chain. They strictly applied the quality standards as malt quality is highly dependent on the quality of barley grain (source = key informant interviews). In-depth interviews taught us that the main factors that affect the malting quality of barley include the variety used, the agronomic practice, crop management, and the post-harvest handling. We asked farmers how they determine the quality of malt barley and most of them use colour, grain size, absence of foreign matter, and varietal purity as key parameters. Traders used the same parameters.

4. Research Methods

4.1 Data collection

We collected primary data using a cross-sectional survey in April-May, 2015. A multi-stage sampling technique was employed to select farm households. First, we purposively selected Lemu Bilbilo district in the Arsi highlands. Second, we selected seven POs of which four are participating in a modern chain and three are in a conventional chain (Table 1 and Figure 3). In Table 1, we present the basic characteristics of the seven POs including information on membership size, gender composition, and whether they are involved in CFAs (CFA status). The selected POs are rather diverse: the membership size varies from 164 to 367 farmers; the

female membership ranges from 3 to 10 percent; the average entrance fee varies from 20 to 50 Birr; and the POs are 3 to 16 km away from the district market.

Figure 3 shows the sample of malt barley farmers by the types of value chains and PO membership. POs are involved both in the modern and conventional chains. Four of the total sampled POs (PO_1–PO_4) are linked to the modern chains, while the other three (PO_5– PO_7) operate in the conventional chains. In addition, we have sampled independent farmers who participate in the conventional chains.

Finally, we randomly selected farmers from the PO member lists. We also selected independent farmers from similar villages using a snowball approach. During the selection of farmers for the sample, support was obtained from PO leaders. The final sample includes 258 households, including 110 who participated in the modern chains and 148 (70 independent farmers and 78 PO farmers) who sold their malt barley via the conventional chains (Table 1). A questionnaire was prepared and carefully administered to gather household-level data. Well-trained enumerators were used to collect the data through face-to-face interviews. In addition, semi-structured interviews were conducted with key informants and actors within the value chains to gather insights from experts.

4.2 Econometric approach

To identify the determinants of quality improvement at micro level, we used an ordered logistic regression model. If the dependent variable Y is an ordinal variable and the categories can be ordered in a natural way, such as in the case of a 3-point Likert scale (i.e. from 1 = low quality to 3 = high quality), the ordered logistic regression model can be applied (Grilli and Rampichini, 2014). According to these authors, the ordered logistic regression model can be specified as follows:

$$\log\left(\frac{p_i}{1-p_i}\right) = \alpha_i + \beta_j x_j, i = 1, 2, \dots, K-1 \quad (1)$$

Where p_i is the probability of being assigned to one of the categories i+1,… k; β is the vector of model parameters; x_j is the vector of the independent variables for the j^{th} observation. The parameter α_i is called threshold or cut-off point and satisfies the constraints $a_1 \leq a_2 \leq \dots \leq a_{k-1}$. The use of this model is justified by the ordinal nature of our dependent variable. We used STATA 14 software to estimate the ordered logistic regression model.

In addition, to check potential multicollinearity we conducted two prominent tests. First, we conducted correlation analysis among the control variables. Second, an Ordinary Least Squares (OLS) model was fitted and the model was tested for multicollinearity using the variance inflation factor (VIF).

Dependent and control variables

Our dependent variable, malt barley quality, is operationalized in terms of perceived improvement in malt barley quality. It is an ordinal variable with ordered categories of quality. To measure the dependent variable, we asked each farmer to state the quality of its malt barley on a scale of 1 to 3, where 1 indicates a low quality and 3 a high quality.

For control variables we used household age, education, entrepreneurial attitude (Table A in the appendix), total livestock, farm income, PO membership, CFA participation, and types of varieties used. In Table 2 we present a summary of the expected signs of the effect of each of the determinants (discussed in Section 2) of quality improvement.

Descriptive analysis was used to characterize and compare the performance of the three groups of malt barley farmers (CFA farmers, PO farmers, and independent farmers) in terms of socioeconomic attributes, access to technologies, organizational characteristics, and selected performance indicators. We used a non-parametric Kruskal-Wallis (KW) test and a chi-square test for the comparative analysis of the three groups. Correlation analysis and box plots were used to examine the relationship of product quality with prices and net income per hectare. The KW test was also used to check the strength of the associations among quality and prices and net income. As some of the variables in our analysis are Likert scale variables (e.g. entrepreneurial attitude and innovativeness) we used Cronbach's alpha to check for internal consistency.

5. Empirical results

This section presents the findings of the study in three parts. First, we present the results of the comparative analysis of the three groups of malt barley farmers. Then, we present the results on whether or not investing in malt barley quality pays-off for smallholder farmers, using correlation analysis. Finally, we provide the results on the determinants of farmers' performance in quality improvement.

5.1 Descriptive results

Comparative analysis on household and farm characteristic for CFA, PO, and independent farmers

In Table 3, we present farm level summary statistics. We present the mean values of the three groups of farmers in terms of farmer characteristics, resource endowment, organizational characteristics, and access to technologies. Farmer level of education, available family labour, entrepreneurial attitude, innovativeness, and family size are significantly different among the three groups. CFA farmers are higher educated, have a more entrepreneurial attitude and show more innovativeness than the other two groups. In contrast, PO farmers have more family members in the household and more labour available.

Farm resources enable farmers to implement farm management practices that affect technology use, crop yield and quality. Farmers with more resources are more likely to invest and engage in quality upgrading activities. Especially when farmers target high-value markets they require more resources for land preparation, weeding, harvesting, and post-harvest product handling. As can be observed in Table 3, farm size, malt barley area, and total livestock holdings are significantly different among the three groups of farmers. PO farmers have larger farms and cultivate a larger malt barley area than the other two groups of farmers. However, CFA farmers have more livestock.

The other factors associated with quality upgrading at farm level are access to new technology and organizational characteristics. Two key institutional arrangements, namely PO and CFA, are identified to promote product quality and link farmers to modern value chains. On average, about 43% of the sample producers participated in CFAs and sold their malt barley through the modern chains. Interview results indicate that in the CFAs the agribusiness companies provide modern inputs and specialized extension to malt barley producers. On average, about 30% of the sample producers are member of a PO and sell malt barley through spot market transactions in the conventional chains. In the field, we observed that POs provide a range of services including improved seeds, fertilizers, market information, and technical assistance. All these services have positive implications for improving crop productivity and quality. The remaining 27% of sample producers did not belong to a PO or a CFA.

In the study area, malt barley farmers have used various improved varieties, including Holker, Miscal-21, Sabini, and Traveler. The use of the Holker variety is significantly different among the three groups. All contract farmers used Holker, and PO farmers used Holker (55%) and Miscal-21(45%). Independent farmers have used all types of varieties (Table 3). Malt barley farmers used three types of fertilizers: DAP, Urea, and NPS. The use of DAP fertilizer is significantly different among the three groups of farmers. Contract farmers

used more DAP than PO farmers and independent farmers. The three groups are significantly different in the use of the weed controlling herbicide 2-4-D.

Our comparative analysis can be summarized as follows: (a) Contract farmers have higher education and have a more entrepreneurial attitude, which could help them to understand the importance of quality upgrading and accessing better market opportunities; (b) PO farmers have more family labour, larger farms, and cultivate more malt barley, which could improve their capacity to improve quality; and (c) CFA farmers use more modern inputs such as fertilizers, which could ease quality improvement.

5.2 Economics of quality production

Does investing in malt barley quality pays-off for smallholders? The Pearson correlation test result (r = 0.726***) shows that malt barley quality is positively correlated with the selling price. This means, farmers receive a lower price for lower quality and a higher price for higher quality, indicating that quality is rewarded in malt barley transactions. As the multinational brewers place more emphasis on the quality of malt barley, they motivate producers through a price premium for quality. The KW test result ($\chi^2(2) = 152.52$***) also indicates that there is a significant difference in selling price among the low, medium and high quality groups.

Product quality improvement entails adoption of improved technologies and increasing efforts and costs at the farm level. Smallholders need to invest time and resources to produce better quality malt barley, thereby increasing the cost of their farming business. Thus, to proof that investing in malt barley quality pays-off one needs to test the association of product quality and net return or income. The correlation result (r=0.363***) indicates that there is a significant positive correlation between malt barley quality and net income per hectare.

The box plots in Figure 4 also show that net income per hectare varies among the three quality groups. Malt barley net income is much higher in the high quality group than in the low quality group. The KW test result ($\chi^2(2) = 26.285$***) also revealed that the difference in malt barley net income is highly significant among the three quality groups. Thus, although investing in quality increases farm expenses (costs for herbicides, improved seeds, fertilizers, and labour); it pays off as farmers obtained higher malt barley net income per hectare.

5.3 Determinants of quality upgrading

What factors determine smallholders' decision to improve malt barley quality? The summary of model results is presented in Table 5. The likelihood ratio statistics as indicated by Model χ^2 are highly significant (P<0.000), suggesting the model has a strong explanatory power. The pseudo R^2 value (0.29) is also high, suggesting a good fit of the model. The parameter estimates of the ordered logistic regression model provide only the direction of the effect of the covariates on the dependent variable. As the coefficients do not represent the actual magnitude of change, the marginal effects are estimated to measure this magnitude (Table 6). In addition, multicollinearity is not a serious problem in this model as the correlation coefficients for all covariates (Table 4) are less than 0.7 (0.005 – 0.636) and the VIF are less than 10 (1.03 – 4.19).

As can be observed in Table 5, age, entrepreneurial attitude and education positively and significantly affect smallholder performance in improving quality. This is plausible as education improves the ability to interpret information related to quality. Age of the household is considered as a proxy for experience in farming, which would support quality improvement. Farmer entrepreneurial experience links to her ability to recognize new (income) opportunities by improving quality.

As expected, our results show that PO membership, participation in a CFA, and the use of improved seed varieties increase the likelihood of improving quality by smallholders. The possible explanation for this pattern is that POs and CFAs facilitate the provision of modern inputs, new technology, and technical assistance, which help farmers to improve crop productivity and quality. These institutional arrangements also help smallholders to link-up with remunerative markets and ensure premium prices. Surprisingly, resource endowment indicators, such as total livestock and farm income, are not significantly determining quality improvement at farm level.

In Table 6 we report the marginal effects, which measure the expected change in the probability of a particular decision being made with respect to a unit change in a covariate. Farmer entrepreneurial attitude increases the likelihood of improving malt barley quality. For instance, a unit increase in the score of entrepreneurial attitude, say from "neutral'' to "agree'', would result in a 2% and 13% less likeliness to be in the low and medium quality category respectively and 15% more likeliness to be in the high quality category. A unit increase in education and age of the household head results in a 2% and 0.8% increase in the probability of being in the high quality category respectively. The probability to participate in quality improvement is higher

among smallholders linked to CFAs. A unit increase in contract participation would increase the smallholder chance of producing high malting quality barley by 61%. The probability to participate in the quality improvement is higher for smallholders who belong to POs. Being member of a PO increases the likelihood of producing high quality malt barley by 24% (Table 6).

As expected, utilization of improved varieties has a positive and significant impact on the probability to improve malt barley quality by smallholders. The probability of producing better quality malt barley is higher for smallholders who used the Holker, Sabini, or Traveler variety. For instance, the marginal effect results indicate that a unit increase in the use of Holker, Traveler, or Sabini variety would result in a16%, 42%, and 24% increase in the probability of being in the higher quality category respectively.

6. Discussion

The study of coordination, collaboration and quality alignment in agri-food supply chains has become increasingly important in developing and emerging economies. Researchers and development practitioners acknowledge the relevance of coordination and value chain organization for better smallholder linkage to higher-value markets (Dries et al., 2009; Poulton et al., 2010; Swinnen, 2016). In our study, we focus on the factors affecting farmers' decisions to improve product quality. Using insights from literature, we developed a conceptual framework for determinants of quality improvement at micro level. We argued that product quality improvement at farm level is conditioned by a combination of farm/farmer characteristics, supply side factors and demand side factors. At micro level, smallholders' quality improvement performance is influenced by socioeconomic characteristics, availability of modern inputs, access to services, participation in particular institutional arrangements, and the availability of exacting buyers.

We applied the conceptual framework to Ethiopian barley value chain and validated it using cross-sectional survey data from 258 farms. With a fast growing brewery industry, the market demand for malt barley is increasing at a rate of 20% per annum (Delelegne, 2017). This can create a lucrative market for malt barley farmers and thereby can reduce rural poverty. However, farmers will only benefit from the growing demand if the malt barley supplied meets the quality requirements of the brewery companies.

Quality improvement activities such as timely weeding, proper harvesting and storing, and post-harvest handling require more resources and investment. As improving product quality entails cost (Mujawamariya

et al., 2012), farmers need to obtain additional revenues to cover these costs. Thus, farmers invest in quality improvement only if they trust that their quality improvement activities will be duly rewarded (Abate and Bernard, 2017). For instance, according to our key informant interview results, in the conventional malt barley chains farmers could not invest more on cleaning products and other postharvest handling as local collectors and traders do not properly reward them for supplying high-quality barley. In contrast, farmers decide to invest in quality upgrading in the modern chain as companies guarantee them a price premium for high-quality malt barley.

Our analysis also reveals that smallholders' participation in specific institutional arrangements has a positive effect on improving malt barley quality. POs and CFAs are the two institutional arrangements that facilitate coordination in malt barley value chains. Brewery companies provide improved seeds and pesticides to farmers and agree to buy the malt barley against premium prices. CFAs are used to safeguard the vertical coordination between smallholders and companies. Contracting helped farmers to access modern inputs, which, in turn, increased productivity and farm income. Many studies have also shown the positive role of CFAs in integrating smallholders into high-value markets (e.g., Abebe et al., 2013; Mwambi et al., 2016; Otsuka et al., 2016). However, we need to point out that not all farmers could benefit from the CFAs in malt barley chain. The companies were only selecting those farmers that are able to produce the quality and quantity of malt barley demanded. This raises the concern about the inclusion of low resource-endowed farmers in the CFAs. Previous research has shown that contractors such as multinational companies often eschew contracting with poor farmers due to the high transaction costs involved (Barrett et al., 2012).

POs can reduce transaction costs and integrate smallholders into the modern food value chains. They provide multiple services such as improved seeds, fertilizers, and technical assistance to farmers, which is critical for enhancing malt barley quality. Earlier studies reported similar results on POs helping smallholder farmers in meeting quality requirements and linking them to changing food markets (Faysse and Simon, 2015; Francesconi and Ruben, 2012). However, there is also evidence that POs could be less inclusive and only select specific members when targeting higher-value markets (Bijman et al., 2016; Lutz and Tadesse, 2017). Many POs in Africa face internal and external challenges and are not able to deliver the products that high-value markets demand (Shiferaw et al. 2011; Tefera et al., 2016a).

Our results also show that the use of improved seed varieties positively relates to the likelihood of improving malt barley quality. This is in line with Shiferaw et al. (2014), who showed that adoption of new varieties

improved productivity and quality in wheat value chains in Ethiopia. Finally, we found that household age, level of education, and entrepreneurial attitude increases smallholder performance in quality improvement. Importantly, we found that farm resource endowment does not determine malt barley quality improvement. This is a bit surprising. Contrary to our result, Kebebe et al. (2017) have shown that farm resource endowment reinforces farmers' capability to adopt technologies and access modern dairy value chains.

7. Conclusion

Driven by internal and external factors, food value chains in sub-Saharan Africa (SSA) undergo major changes (Tschirley et al., 2015; Minten et al., 2016). These changes are characterized by dietary transition, increasing demand for high-value products – such as fruit and vegetables, dairy products, fish, and meat – expansion of modern retail formats, and rising consumer demand for safety and quality. Quality upgrading in food value chains has received considerable attention from policy makers and researchers. However, research has not paid much attention to the micro-level impact of the demand for higher quality and to the conditions under which different farmers are able to comply with higher quality requirements.

Our findings show that, consistent with previous research, the performance in quality improvement is determined by demographic, economic and institutional factors. We found that entrepreneurial attitude and better education positively affect smallholder performance in improving quality. Presumably, education and entrepreneurial attitude allow farmers to interpret market information and recognize opportunities. We expected that resource-endowed farmers would be better able to improve the quality of their products. However, our resource endowment indicators, such as total livestock and farm income, are not significant in affecting smallholder quality performance. We do find that membership of a producer organisation or participation in a contract farming arrangement increase the likelihood of improving quality. Both institutional arrangements provide farmers with access to better seeds and technical assistance.

Our findings have implications for development policy. The study indicates that access to and use of improved seeds are key determinants for improving product quality in the upstream part of the supply chain. This suggests that strengthening local seed systems, including the sufficient supply of seeds of improved varieties, can help farmers to upgrade their farming activities. Our research also reveals that institutional arrangements are important for facilitating coordination between actors in the chain. Public and NGO support for setting up

and maintaining POs seems a good development strategy. In addition, CFAs seem to benefit the barley farmers, although development literature is inconclusive on whether CFAs in general are favourable for smallholders (Bellemare and Bloem, 2018). Our findings will also be of interest to businesses and practitioners. For instance, to build efficient supply chains and maintain sustainable sourcing from smallholders, companies are advised to strengthen the involvement of POs that can provide intermediary services and reduce transaction costs.

Our study has explored the quality improvement process and its impact at an early stage of the 'intervention'. International brewers have invested heavily in developing modern supply chains for good quality malt barley. At the initial stage of the 'intervention', farmers need to be induced to switch to other varieties, other cultivation techniques and other buyers. Whether the benefits that farmers currently experience will continue into the future, and whether the distribution of benefits along the value chain will be 'fair', is an interesting topic for further research.

We are aware of the limitations of our study. First, a generalization of the conclusions is limited to the extent that we only explored one case, even though the case provides in-depth perspectives of quality improvement at micro level. A cross-case comparative study or a meta-analysis on existing case studies and quantitative assessments could provide more general conclusions. Second, in our empirical analysis we assumed that farmers know their products when assessing the quality. However, there may be a bias due to a lack of knowledge among the farmers about intrinsic and extrinsic product quality attributes. This limitation could be solved by including a measurement of the technical characteristics of the barley grains. Third, selecting our sample of farmers is not possible with consent of the local authorities and PO leadership. This could have resulted in slight bias towards better-off farmers. However, we believe, based on observations and in-depth knowledge of the study area, that this bias is very limited.

Table 1. Characteristics of selected producer organizations and the size of the member samples

Villages	PO#	# of farmers selected	Membership			Entry fee (Birr)	CFA status	Distance to market (Km)
			Male	Female	Total			
Bekoji Negesso	PO_1	29	329	38	367	20	Yes	3.0
Lemu Dima	PO_2	28	266	29	295	20	Yes	6.8
Lemu Burkitu	PO_3	23	242	22	264	35	Yes	9.6
Chiba Micheal	PO_4	30	345	10	355	24	Yes	3.6
Lemu Micheal	PO_5	25	359	8	367	50	No	8.1
Ululee Hassa	PO_6	26	181	8	189	20	No	12.3
Koma Katera	PO_7	27	158	6	164	50	No	16.2
	Non-member	70					No	
Total		258			2,001			

Source: Authors computation from the survey and interview data

Table 2. Expected effect of variables on quality improvement

Variables	Measurement and description	Expected effect
Farmer characteristics		
Entrepreneurial attitude	Household head entrepreneurial competence	+
Education	Household head years of schooling	+
Age	Age of the Household head in years	+ -
Resource endowment		
Farm income	Percent of income from the sale of crop, livestock, and land rent out)	+
Total livestock	Household's livestock ownership in TLU[a]	+
Technology		
Holker variety	Household use of Holker seed variety (0-1)	+
Traveler variety	Household use of Traveler seed variety (0-1)	+
Sabini Variety	Household use of Sabini seed variety (0-1)	+
Institutional arrangements		
CFA participation	Household participation in CFAs (0-1)	+
PO membership	Household membership in POs (0-1)	+

Note: a = TLU = Tropical Livestock Unit, describes livestock numbers of various species as a single unit

Table 3. Comparison on household and farm characteristics for CFA, PO, and independent farmers

Variables	CFA farmers (n=110)	PO farmers (n=78)	Independent farmers (n=70)	P-value
Farmer characteristics				
Age	44.55	45.45	42.72	0.447
Education	5.96	4.03	5.11	0.000***
Family size (#)	6.22	7.37	5.44	0.000***
Family labour (#)	3.82	4.48	3.28	0.000***
Farming experience (years)	23.11	23.72	20.70	0.288
Entrepreneurial attitude[a]	3.76	2.79	2.51	0.000***
Innovativeness[a]	4.06	2.89	2.54	0.000***
Resource endowment				
Farm size (ha)	2.70	3.73	1.76	0.000***
MB area (ha)	0.79	0.94	0.43	0.000***
Farm income (%)	96.81	96.15	92.64	0.371
Off-farm income (%)	3.18	3.85	7.36	0.371
Total livestock (#)	14.45	11.47	5.39	0.000***
Organizational characteristics				
CFA participation (0-1)	110 (100%)	0	0	-
PO membership (0-1)	110 (43%)	78 (30%)	0 (27%)	-
Technological characteristics				
Holker variety (0-1)	110 (100%)	43 (55%)	14 (20%)	0.000***
Traveler variety (0-1)	0	0	6 (8.6%)	-
Sabini Variety (0-1)	0	0	27(38.5%)	-
Miscal-21 variety (0-1)	0	35 (45%)	23 (33%)	0.000***
DAP fertilizer (qt)	2.6	1.6	1.7	0.000***
Urea fertilizer (qt)	0.48	0.47	0.31	0.409
NPS fertilizer (qt)	1.96	0.87	1.72	0.126
Herbicide 2-4-D (0-1)	73 (66%)	65 (83%)	48(69%)	0.034**
Herbicide 2-4-D (litre)	1.12	1.4	0.85	0.004***

Source: Survey, 2015; ** P < 0.05, *** P < 0.01; qt = quintal = 100kg; MB = malt barley; ha = hectare; a = Likert scale variables with 5 scales

Table 4. Correlation matrix

	Variables	1	2	3	4	5	6	7	8	9	10
1	Entre. attitude	1									
2	Education	0.302	1								
3	Age	-0.305	-0.489	1							
4	Total livestock	0.115	-0.005	-0.013	1						
5	Farm income	-0.026	-0.169	0.252	-0.090	1					
6	CFA participation	0.595	0.196	0.017	0.073	0.115	1				
7	PO membership	-0.241	-0.206	0.064	0.006	0.044	-0.567	1			
8	Holker variety	0.427	0.071	0.011	0.038	0.109	0.636	-0.132	1		
9	Traveler variety	-0.022	-0.020	-0.151	-0.022	-0.084	-0.133	-0.101	-0.209	1	
10	Sabini variety	-0.216	0.028	-0.073	-0.052	-0.188	-0.294	-0.225	-0.463	-0.052	1

Source: Author's computation based on survey data

Table 5. Parameter estimates of the ordered logistic quality improvement model

Covariates	Coef.	Std. err	Z	P >|Z|
Entrepreneurial attitude	0.599***	0.218	2.74	0.006
Education	0.095*	0.049	1.93	0.054
Age	0.035**	0.016	2.15	0.032
Total livestock	0.005	0.011	0.41	0.678
Farm income	0.017	0.014	1.25	0.210
CFA participation	2.866***	0.578	4.96	0.000
PO membership	0.994**	0.441	2.26	0.024
Holker variety	0.656*	0.394	1.66	0.096
Traveler variety	2.290**	0.968	2.36	0.018
Sabini variety	1.015*	0.554	1.83	0.067
/cut 1	4.263	1.759		
/cut 2	7.815	1.847		
***Model diagnostics*:**				
Pseudo R^2 = 0.2948				
Model χ^2 = 140.65***				
Log likelihood = -168.24				
Number of observations = 258				

Source: Author's calculation based on survey data; * P < 0.10, ** P < 0.05, *** P < 0.01

Table 6. Marginal effects from ordered logit quality improvement model

Covariates	Low		Medium		High	
	Coef	p-value	Coef	p-value	Coef	p-value
Entrepreneurial attitude	-0.017**	0.015	-0.133***	0.007	0.149***	0.006
Education	-0.003*	0.071	-0.021*	0.057	0.023*	0.054
Age	-0.001**	0.048	-0.008**	0.034	0.008**	0.032
Total livestock	-0.0001	0.677	-0.001	0.679	0.001	0.678
Farm income	-0.001	0.222	-0.004	0.212	0.004	0.210
CFA participation	-0.086***	0.002	-0.524***	0.000	0.610***	0.000
PO membership	-0.024**	0.021	-0.217**	0.020	0.241**	0.017
Holker variety	-0.020	0.148	-0.142*	0.086	0.162*	0.089
Traveler variety	-0.027***	0.001	-0.391***	0.000	0.418***	0.000
Sabini variety	-0.020**	0.020	-0.219**	0.047	0.239**	0.041

Source: Author's calculation based on survey data; * P < 0.10, ** P < 0.05, *** P < 0.01

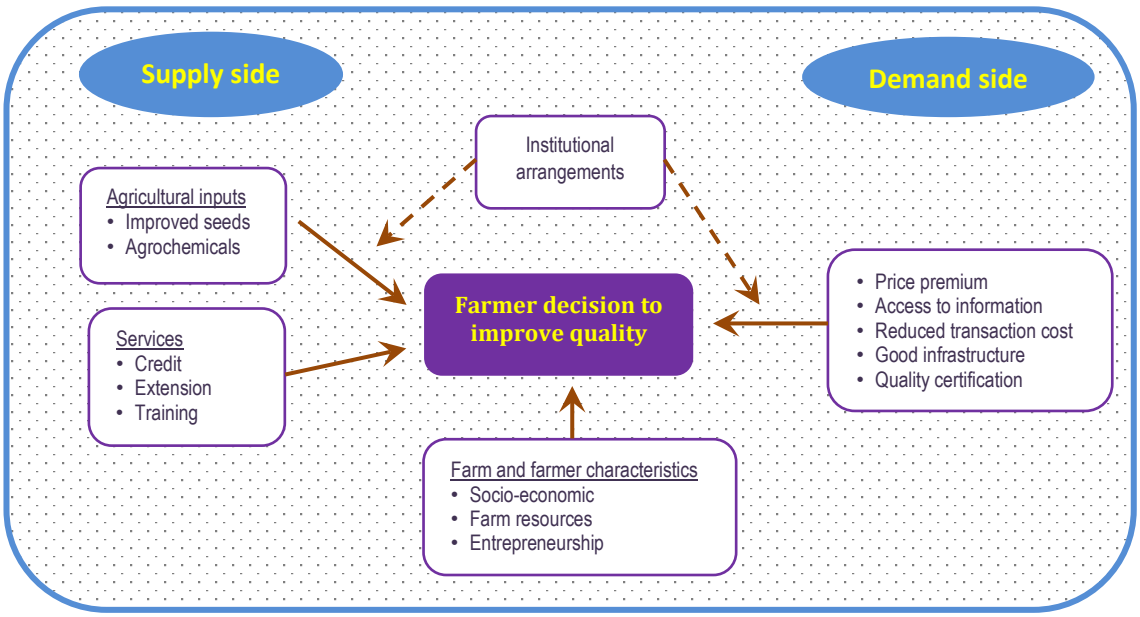

Figure 1. Conceptual model of determinants of quality improvement decision

(Source: Authors' Design)

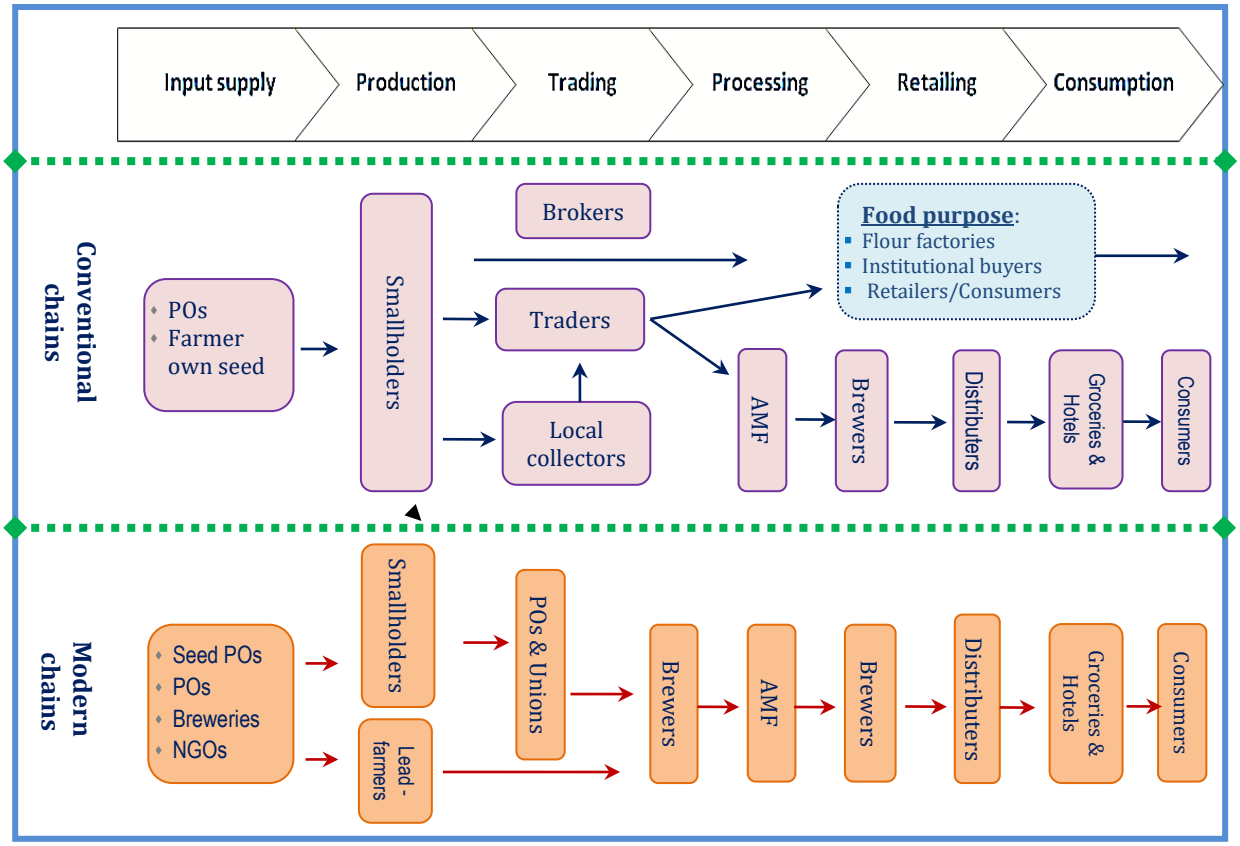

Figure 2. Conventional and modern value chains; Source: Adapted from Tefera et al. (2016b)

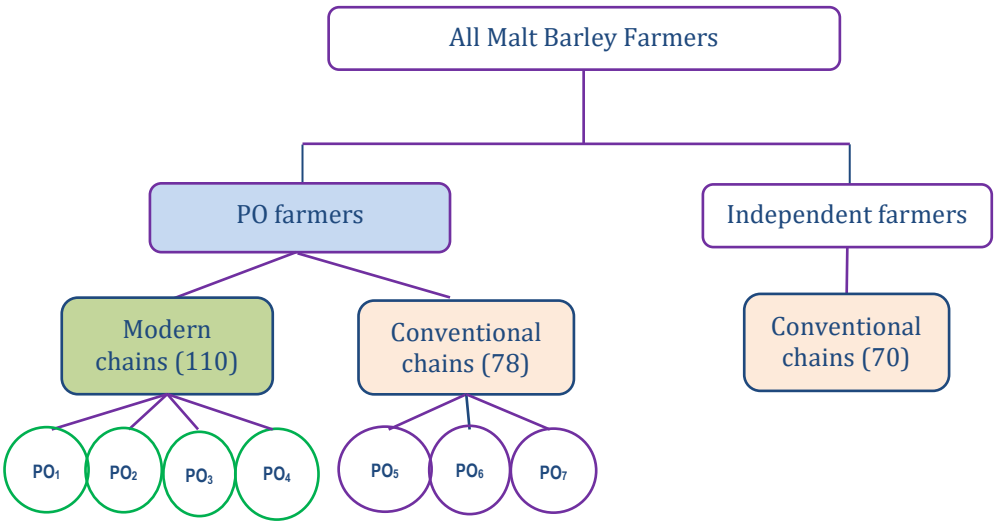

Figure 3. Malt barley farmers by PO membership and type of value chains (Source: Author's Design)

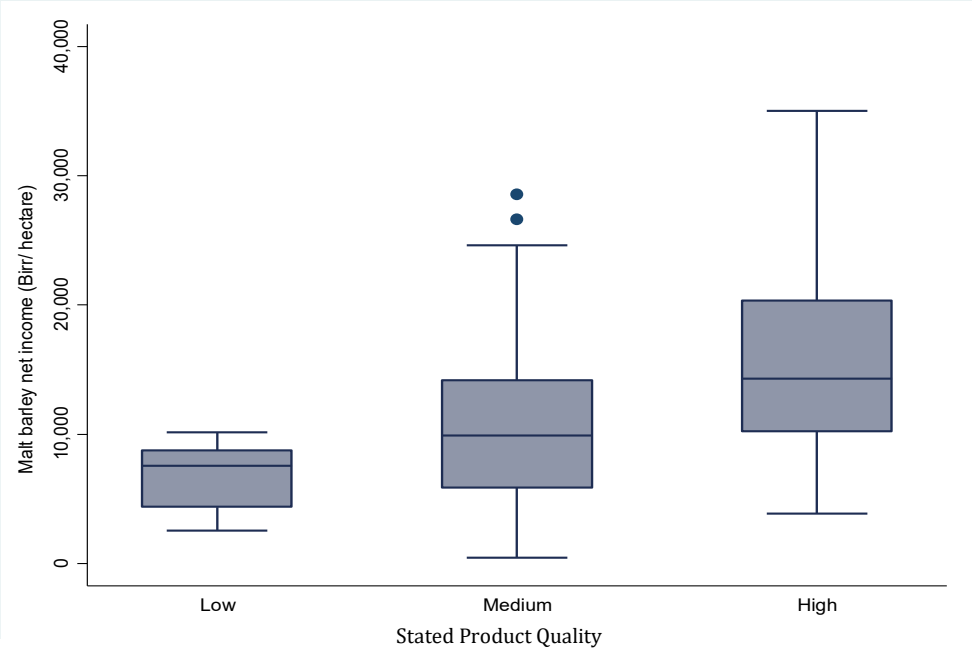

Figure 4. Net income and product quality relation

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Appendix

Table A. Entrepreneurial attitude of farmers

Measure	Description	Questionnaire items
Entrepreneurial attitude	Entrepreneurial competence of households measured on a Likert scale of 1-5.	I always like to search for the latest information
		I like to try new technology in my farm
		I am actively seeking new markets
		I am willing to use new varieties
		I see and recognize good chances

Source: Verhees, F. J. H. M., Lans, T., & Verstegen, J. A. A. M. (2012). The influence of market and entrepreneurial orientation on strategic marketing choices: the cases of Dutch farmers and horticultural growers. Journal on Chain and Network Science, 12, 167-179.