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Quality upgrading in Ethiopian dairy value chains: dovetailing upstream and downstream perspectives

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ABSTRACT

In this article, we analyze opportunities and constraints for upgrading product quality in the dairy value chain in Ethiopia. Our analysis is based on an integrated understanding of supply chain performance both from producer and from consumer perspectives. We outline as main drivers for quality upgrading: (a) factors that influence producers' willingness to invest toward intensification by smallholder dairy farmers and cooperatives and (b) factors that induce consumer's willingness to pay for healthy and nutritious dairy products delivered at specific retail outlets. Since there are large gaps between upstream producers incentives and downstream consumers motives, possibilities for dairy quality upgrading remain fairly limited. Given this market structure, decisive policy support is required for better tailoring producer's investments with consumer preferences.

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1. Introduction

Smallholder commercialization is frequently considered as a key development strategy in many African countries. There is growing evidence indicating that increasing returns from agricultural production vitally depend on the expansion of viable market opportunities (Gabre-Madhin and Haggblade 2004; Njuki *et al.* 2011). The commercial transformation of smallholder agriculture is considered as an important pathway for the development of the agricultural sector (World Bank 2008), for reinforcing economic growth and macroeconomic development (Timmer 1997), and to support household food security and welfare (Pingali

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1997). However, many smallholders meet sooner or later serious constraints in delivering their products to more demanding peri-urban retail outlets, where quality, safety, and taste criteria are important for receiving higher prices and better margins.

Policy-makers, agricultural research institutes, and development organizations in Africa are now shifting attention from enhancing productivity of food crops and livestock to improving profitability and competitiveness of the smallholders by linking them to urban retail markets (Njuki *et al.* 2011). Many of these efforts are based on providing farmers with market information, organizing farmers into marketing groups, associations and cooperatives, and coordinating contract farming and outgrower schemes (Fischer and Qaim 2012). Although it is commonly supposed that farmers need such market incentives to enhance their intensification efforts for guaranteeing stable and reliable dairy supplies, there are growing concerns that such market-based development approach may be captured only by rich farmers, since assets required for acceding new market opportunities can displace local smallholders, and that income control may shift from women to men (Jaleta *et al.* 2013; Njuki *et al.* 2011; Sahan and Fischer-Mackey 2011).

On the other hand, consumer preferences and shopping habits are also rapidly changing. Peri-urban consumers face a wider choice of outlets and supermarkets are taking a growing market share (Tschirley *et al.* 2014). Quality of products and reputation of stores are vital in shaping the choice of consumers for particular shops and markets. Ethiopian households still are less likely to buy processed dairy from modern retails outlets because open market offer dairy products that respond better to their taste and convenience criteria. Consequently, traditional outlets remain important and incentives for quality upgrading stay rather limited.

This article aims to understand the supply side and demand side incentives for dairy chain upgrading in Ethiopia. We focus attention on the opportunities and constraints for enhancing product quality improvements, either through shifts in consumer demand and/or by improving returns to producers. Quality upgrading is required to enable more value added and to establish a dynamic competitive advantage for producers, but also needs to respond to changing consumer preferences regarding the purchase and sensory characteristics of dairy products. The Ethiopian dairy sector thereby faces a clear paradox: while the agro-ecological potential for dairy is extensive, yet average consumption (21 kg/year/capita) and milk production (1.5 liter/day/cow) rank historically low on the African continent (Yilma *et al.* 2011).[1] Producers and consumers face both

[1]Low consumption is partly due to the long fasting season among Ethiopian Orthodox Christians that compose 43.5% of the population, abstaining from consuming animal origin products for more than 200 days. This, however, is changing rapidly because of fast urbanization, demographic change and change in diet pattern that includes more dairy and vegetables (Bekele *et al.* 2016a). The increasing capacity of dairy industries in converting fresh milk into others types of dairy products also has reduced the effect of fasting on milk production and consumption.

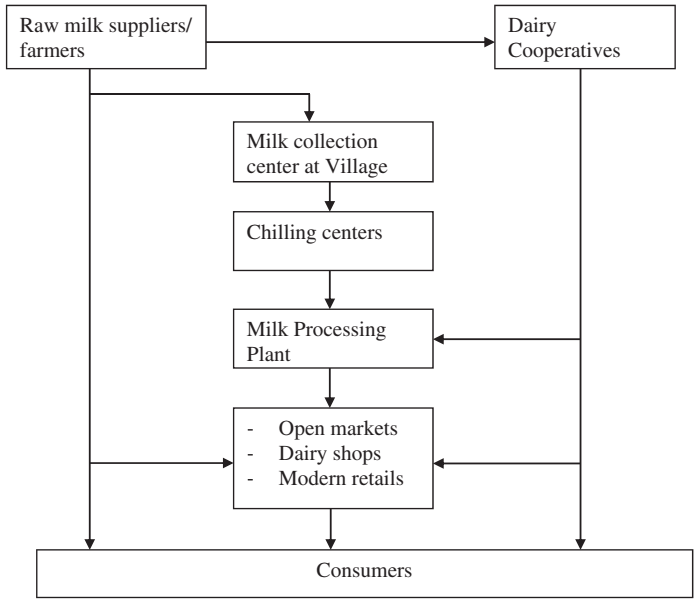

Figure 1. Supply chain structure of dairy in the greater Addis Ababa Milkshed, Ethiopia (adapted from: Lemma *et al.* 2015).

structural and behavioral constraints that limit opportunities for resource intensification and quality upgrading. Supply chain transformations can thus only advance gradually by balancing producer incentives and consumer responses.

The dairy supply chain in Ethiopia (see Figure 1) is composed of two types of producers (independent smallholders and dairy cooperatives) and different types of market outlets (local shops, open market, supermarkets). About 75% of all commercial milk passes through dairy cooperatives. Part of the milk is processed (into pasteurized milk, reduced fat milk, butter, cheese, and yogurt), whereas another share is directly sold and consumed in its raw state. Differences in animal care (feeding, grazing), breeds, product management (fat and protein content) and handling (cooling, transport) result in a high degree of market segmentation (Ruben and Heras 2012). This severely hinders incentives for intensification at the producer's end of the supply chain. Moreover, consumer demand for improved dairy products is also limited, thus restricting their willingness to purchase higher quality dairy products.

Despite stagnant milk production, milk supply has surged. In 2014, Ethiopia produced 4 billion liters of milk, but only 6% is marketed while the rest is processed at home or used for local in-kind payments (CSA 2003; Yilma *et al.* 2011). According to Lenjiso *et al.* (2016b) intra-household income distribution and labor norms also hinder smallholder milk supply to urban market outlets in Ethiopia. Average milk output per cow remains too low for reaching economies of scale

in production. At the demand side, population growth, increasing urbanization, rising incomes, make up for a growing market for dairy products. Ethiopia has therefore become a net importer of milk products with an import bill rising from U.S.$ 5.6 million in 2005 to U.S.$ 7.6 million in 2014. Consumer demand for improved dairy products is still quite limited. Little is known on whether consumers' desires to upgrade toward improved dairy products (pasteurized and reduced fat, etc.) and to what extent they are willing to pay for it. Improving productivity alone has limited effect for enhancing the competitiveness of dairy chains (Duncan *et al.* 2013), since informal retail outlets rely on long embedded local quality standards. Integral quality upgrading – both at upstream product level and at midstream and downstream process and institutional level – is thus essential.

Basic information for this article is derived from two different field surveys. Producer data are collected from farm households in Selale, one of the most important dairy production areas in Oromia region (Lenjiso 2016). These households also participated in experimental games and observational studies to understand their investment decisions. Consumer data are collected among urban and peri-urban households around Addis Ababa capital (Bekele *et al.* 2015). In order to understand consumers' propensity for buying higher quality dairy products, we used framed market experiment and experimental auctions that provide insight into perceived trade-offs between nutritional quality and taste preferences. Further, we look into the role of extrinsic (health information and nutrition labeling) and intrinsic product (taste) characteristics in quality upgrade decisions.

The remainder of this article is structured as follows: in Section 2, we outline different pathways for value chain upgrading, distinguishing between investments that focus on area expansion (extensive growth), yield improvement through better input applications (intensive growth), and quality improvement, also outlining their different resource and institutional implications. In Section 3, we discuss the specific methodological approach used in the field studies. In Section 4, we further elaborate the incentives for enhancing smallholder farmers in Ethiopia toward in-depth investments into the intensification of dairy production. In Section 5, we report on similar requirement for convincing urban Ethiopian consumers to express their willingness to pay (WTP) for higher quality dairy products. Given the high degree of market segmentation and the constraints for quality upgrading, we outline in Section 6 some strategic policy options for overcoming the registered dilemmas.

2. Pathways for value chain upgrading

Different pathways for value chains improvement can be outlined offering opportunities for increasing production (output) or productivity (efficiency) through adjustments in the use and combination of resources and market

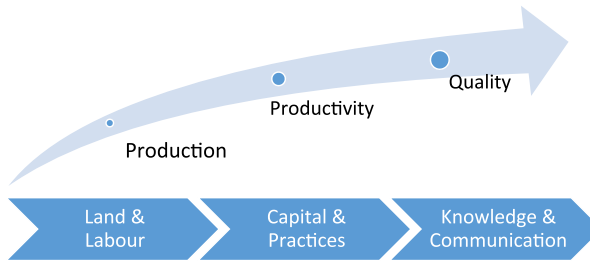

Figure 2. Pathways toward Dairy Upgrading.

relationships. Common production system-oriented pathways are usually qualified as strategies toward either 'extensification' (= area expansion) or 'intensification' (= increasing input use or higher herd density) from the production or supply side. The alternative pathways of improving factor returns (value added) and product quality is usually driven from the demand side and based on the combination of product and process innovation (Humphrey 2004; Lee *et al.* 2012). Quality upgrading aims to improve milk quality in terms of reduced saturated fat content in milk and removing the health threats from fresh milk.

For analytical purposes, we can distinguish different strategies for improving the value added of dairy products that also put different requirements on key resources. Roughly speaking, three key pathways can be distinguished (see also Figure 2):

(a) Horizontal growth through *expansion* of pasture area or herd size (usually defined as extensification);
(b) *Productivity growth* through input intensification, based on better feeding regimes and improved herd management practices (pasture rotation), improved breeds and/or reduced post-harvest losses;
(c) *Quality upgrading* through better product grading and improved value chain integration, taking advantage of knowledge on quality standards, and more intensive agency communication on best practices.

These three typical pathways are comparable to the stages and sources of growth usually distinguished in the economic development processes (Hayami and Ruttan 1971). Most attention is given to the shift from extensive growth toward intensive growth pattern and the requirements in terms of better resource endowment. This transition is strongly driven by a change from land-led to capital-led (or land-saving) agricultural growth associated with improved access to input and finance markets. The third strategy focusing on quality upgrading tends to be more knowledge- and communication-intensive, and also involves other players in the supply chain (especially processors and retailers). It combines product upgrading with channel upgrading since improved quality needs to be maintained throughout the supply chain.

Whereas, broad empirical and conceptual literature is available that assesses the drivers of extensive and intensive growth and their consequences for resource use (Hazell and Wood 2008), far less analyses are available for understanding the step from productivity growth to quality improvement. This transition requires simultaneous changes in supply chain management and process organization (lower transaction and governance costs), as well as adjustments in agency relationships (i.e. risk reduction; trust building) and changes in the knowledge exchange systems. Moreover, investments are required for improving processing and logistical processes that are of vital importance for quality upgrading (Ruben *et al.* 2007).

Given the rapid changes in the retail structure and the increasing importance of grades and standards, quality becomes the key aspect for food sector competitiveness. Key drivers for improving quality performance include: (a) market incentives for enhancing producers' willingness to invest in quality upgrading and (b) consumer's WTP for higher quality dairy products. In the following, we discuss the interfaces between both dimensions of value chain upgrading in the context of the Ethiopian dairy sector. Such quality upgrading requires that innovations emerge from interactions among multiple value chain actors and are based on interactive 'knowledge brokering' that combines technical, social, and institutional change (Klerkx *et al.* 2012). In addition to technical upgrading, also social and organizational upgrading is required in order to avoid that producers become locked-in the value chain and to guarantee that market-based incentives for quality improvement are anchored in broader and long-lasting consumer preferences.

Research evidence that provides insight into the driving forces for quality upgrading of agro-food production is still rather fragmented. Whereas, input intensification is usually driven by efficiency motives and market forces (input/output prices, tariffs, and margins) at the producers side of the supply chain, investments for quality upgrading tend to focus more on improved vertical interchain relationships – through better logistics, contracting, and communication – that reduce risks and control transaction costs (Gereffi 2015). Other literature on value chain upgrading focuses in building strategic resource investments and capabilities building of smallholder farmers to improve their competitiveness (Lutz 2012), yet such 'inward' approach overlook that many smallholder farmers (and particularly in our case) are resource poor.

In the fruits and vegetables chain, important upgrading drivers are provided by grades and standards (also paying attention to recycling of sub-product), cold chain and software solutions that reduce lead time, and changes in sales and contracting regimes (i.e. preferred suppliers, e-commerce). In staple commodities like maize, rice, and wheat, more attention is given to fortification and novel processing, storage, and packaging strategies that also can reduce losses (Demont and Ndour 2015). In several export crops (coffee, tea, cocoa, palm oil), upgrading is mainly reinforced through certification initiatives and market

segmentation for specialty brands. In general, all these initiatives put emphasis on incremental upgrading and the spread of innovations between supply chain parties, through 'learning by doing' and with the gradual implementation of new tasks based on interactions within the supply chain. This approach barely recognizes intra-household constraints that could limit producer's incentives to supply chain upgrading. Moreover, such upgrading tends to be a rather discontinuous process of linking local innovation with value adding initiatives, and is made possible by organizational succession allowing the participation of important change agents.

Looking into empirical evidence regarding the conditions for quality upgrading, Demont and Ndour (2015) – based on in-depth studies from 11 African markets – documented that upgrading of domestic rice quality requires aligning intrinsic and extrinsic rice quality attributes by tailoring them to urban consumer preferences. In the case of dairy chain in Zambia, farmers involved in modern channels greatly benefited from improved breeds, tools, and operational management techniques to increase their milk output (Neven *et al*. 2006); yet they also saw that relative growth in upgrading outstripped relative growth in market volume, suggesting how lags in upgrading productivity growth could dwarf the effect of participation in modern supply channels.

The integration of smallholder farmers into modern, dynamic markets thus requires a balanced approach in which several complementary program elements need to be in place to guarantee the required synchronicity. This requires in turn that development programs involve all relevant stakeholders (private, public, and NGO) and align their activities carefully. Several dilemmas and constraints might be faced in efforts for dovetailing internal and external incentives. In the following, we will first identify which supply-side and demand-side motives are of critical importance for initiating the process of dairy product upgrading. Hereafter, we discuss additional social and institutional changes that will be required to put a sustainable process of upgrading is place. Only if internal and external drivers become complementary to each other, a lasting and inclusive framework for value chain upgrading can be expected.

3. Approach

The aim of this article is to enhance our understanding of quality upgrading strategies in dairy chains. To obtain the necessary information, we use household survey data both at the upstream and downstream side of the dairy value chain. In addition, we conducted field experiments, auctions, and behavioral gaming in selected rural and urban locations in Ethiopia to get insight into potential changes of buying and selling behavior. This is critical for a better understanding of the feasibility and attractiveness of different upgrading options from the welfare perspective of producers and consumers, while recognizing that the required resource transfers could also change (intra-household) bargaining and

(intra-value chain) reliability and trust relationships. The net effects recorded from the intervention (treatment) and the control group are registered as impact. Robust impact analyses – controlling for selection bias – is therefore used to assess the effectiveness of different types of incentives on producers and/or consumer behavior.

3.1. Upstream (producer) analysis

For upstream analysis of the supply chain, producer data were collected from 300 dairy farm households in Selale area, one of the most important dairy production areas in Oromia region by employing survey questionnaire and stratified sampling techniques. After categorizing these households into commercial dairy and dairy subsistence households, 164 households were randomly selected to participate in experimental games and observational studies. We conducted two types of field experiments. The first field experiment aimed at understanding the effect of participation in dairy commercialization on women`s intra-household bargaining power. In this part, we look into both members and non-members market behavior effect on intra-household bargaining power. This is critical for quality upgrading effort in Ethiopia, since dairy used to be mostly a women`s business in subsistence-oriented production system. In this experiment, we asked participants (husband and wife) to play a coordination game, where they indicate the amount of money they want to send to their partner and the amount of money they expect from their partner (Lenjiso *et al.* 2016b). We also conducted detailed observation of intra-household time allocation of adult members and on food consumption and dietary diversity within these households (Lenjiso *et al.* 2015, 2016b).[2]

3.2. Downstream (consumer) analysis

For downstream analysis of the supply chain, consumer data were collected from 600 households: 400 households from Addis Ababa and 200 households from peri-urban cities surrounding Addis Ababa.[3] We conducted field experiments in different market halls and stores. We randomly selected 160 participants from the household survey for participation in two types of experiments. The first aimed at eliciting consumer values for improved pasteurized milk, while the

[2]We also conducted another experiment to understand parental investment in child education in commercial and subsistence households. Therefore, we measured anthropometric indices for children under five and examined association between dietary diversity and nutritional status of children in commercial and subsistence households (see Lenjiso *et al.* 2016a).

[3]Addis Ababa has 10 sub-cities, while peri-urban towns consist of six districts. Two-stage random samplings were used to select households. In the first stage, two districts were randomly selected from each sub-city. Samples were allocated to each district proportional to the size of the population (PPS). Secondly, streets were randomly selected from selected districts. Finally, households were randomly selected from selected districts until the stated sample size was reached.

second experiment aimed at eliciting consumer values for fat-modified milk product. We thus used two types of treatment effects: taste and information.

We applied two types of experimental auctions with groups of 9–13 participants. For the first experiment, we relied on a random nth auction method, where participants simultaneously submit a sealed bid for a good (Bekele *et al.* 2015). The winner is the participant with the highest bid, selected from all participants with a bid greater than a randomly drawn price (nth price). For the second experiment, involving fat-modified milk products, we used Becker–DeGroot–Marschak (BDM) auction mechanism. Participants simultaneously submit a bid for a good, and participants with a bid greater than the randomly drawn price wins the auction (details are described in Bekele *et al.* 2016a, 2016b). All experimental auctions were conducted in four separate stages for each treatment: (1) bidding for two products; (2) tasting products; (3) re-submitting bids for the two products; and (4) providing health or nutrition information.

Experimental auction are considered as more suitable methods compared to the stated preference approach, since in the latter participants face inconsequential questions and have scarce incentive to reveal their true WTP for the product, often resulting in upward hypothetical bias (see: Lusk and Shogren 2007; Lusk *et al.* 2011). In this case, participants bid for baseline and alternative products under framed market environment. Extrinsic and intrinsic attributes of the product can be controlled to disentangle their effect on quality upgrade decision. Experimental auction thus create a real-time market environment in which participants have an incentive to reveal their true preference for the product or characteristics studied.[4]

3.3. Impact analysis

To identify robust impact, participants were randomly assigned to treatment and control groups. Treatments and products were randomized across experimental sessions to avoid confounding effects. All experiments and games were conducted in the local language (Amharic) and framed in the local tradition. In addition to household survey data with information from the participants, we used post-experiment surveys to better understand responses from the experimental sessions. We used descriptive statistics, *t*-test, propensity score matching, and multivariate regressions to analyze the findings (Rosenbaum and Rubin 1983).

The approach of data analysis for the upstream study is based on pairwise impact appraisal, using a comparison of commercial and subsistence households according to their participation in raw milk market.[5] After households

[4]Before running the buying experiment, we used practice round with imported and local biscuits to familiarize participants with the auction mechanism.

[5]Households who supply raw milk to the milk market (through cooperatives, middlemen milk collectors, processing companies, hotels, and cafeterias) are defined as 'commercial households,' while those who produce milk on daily bases but do not sell raw milk are defined as 'subsistence households.'

were selected for experimental games and direct observation, the comparison was made on four major outcome variable; (1) intra-household time allocation, (2) women`s intra-household bargaining power, (3) intra-household milk consumption, dietary diversity and nutritional status of young children, and (4) parental investment in child education.

In the downstream consumer analysis, we provided information about health and nutritional aspects of the product only to the treatment group. We first selected different dairy products for the experiments taking into account the potential for quality upgrading in the dairy chain, with raw milk as baseline and pasteurized milk as an improved quality product. In the second experiment, full-fat milk (whole milk) was used as a baseline product, while reduced-fat milk was taken as alternative healthy product. For the purpose of this study, we only focused on intrinsic and extrinsic quality attributes that are particularly relevant for quality upgrading decisions in the dairy chain. The intrinsic attributes refer mainly to taste, while extrinsic attributes include health information and nutrition information labeling.

4. Intensification of dairy production

Improving dairy production from the supply side implies that substantial investments need to be made for increasing the productivity of dairy farming (e.g. through better feeding, improved breeds, and cattle management) and for enhancing the quality of milk. While most efforts are usually devoted toward increasing total supply volume of fresh milk, and some controls are in place to ascertain safety, far less attention is given to quality upgrading. Moreover, different concepts of 'quality' co-exist, associating with various indicators and properties like fat content, protein content, and acidity.[6]

During early phases of agrarian development, emphasis is usually given to increasing food supply through horizontal (herd size) expansion. This extensive growth path can be supported by specific institutional innovations (e.g. cooperative production) and/or technological adjustments (improved input use, on- and off-farm infrastructures). Shifting toward a more intensive growth patterns requires, however, more substantial changes in trading and information regimes (prices, contracts, grades) that provide farmers with the necessary incentives for implementing these changes. Moreover, requirements for adjusting intra-household organization and labor standards may be major obstacles to dairy upgrading.

Previous studies on Ethiopia dairy development (Ahmed *et al.* 2003; D'Haese *et al.* 2005; Holloway *et al.* 2000) suggest that farmers' participation in dairy cooperatives resulted in a significant increase in the volume of milk production and market supply due to improved productivity. Impact measurements by

[6]Bacterial count is usually applied to verify milk safety.

Francesconi and Ruben (2012) comparing dairy cooperatives with individual dairy farmers suggests, however, that cooperative organization has indeed a positive effect on commercial milk production and cow productivity, but a negative impact on milk nutritional value (fat and protein content) and an insignificant impact on milk hygiene (total bacteria count). These findings indicate that milk production and productivity may increase, while milk quality tends to decrease.

Chagwiza (2014) identified some key reasons why this trade-off between dairy productivity and milk quality is likely to occur in the cooperative context. Cooperative members are usually somewhat poorer farmers with low levels of assets, education and experience. Their collective action is directed mostly toward increasing the scale of production (joint milk recollection and processing) and facilitates the shift toward commercial operations. Furthermore, quality of milk is also determined by the type of cow used, and the animal feeding regime. In the case of dairy cooperatives in Ethiopia, cooperatives tends to distribute (often at lower price than the market), cross-bred cows that give higher milk production but perform lower in terms of milk quality. Adding to this, cooperative farmers rely more on extensive in-door housing for cross-bred cows that are often attached to their main living houses, thus offering limited grazing opportunity. Moreover, it should be noted that positive price effects that usually result from improved cooperative bargaining power, are rarely registered. This may be due to free-riding behavior (side sales), but is also due to the absence of grading systems that provide incentives for upgrading. In a similar vein, there are limited incentives for quality improvement in place that could enforce joint action for upgrading.

Another important reason for the limited progress in the fields of quality upgrading in the cooperative context refers to the technologies in place. Many cooperatives could benefit from support programs that enabled the purchase of cross-bred cows and the use of local improved feeding, leading to a substantial increase in milk productivity (Chagwiza *et al.* 2016). Cross-bred cows produce larger volumes with lower fat and protein content (Walstra *et al.* 2006). Hence, a great deal of the estimated impact can be referred to technological innovation triggered by the introduction of exotic genes in cooperatives herds (Francesconi and Ruben 2012). But cooperative farmers feed their cross-bred cows mainly with dried forages and crop residues, and the lack of more nutritious, concentrated feed, and fresh forage could be a reason for the excessive dilution of nutrients in cooperative milk. Concentrate feed is scarce and expensive, and crossbred cows are kept almost constantly inside the barn, indicating that the lack of grazing could also be part of nutritional shortfalls.

Recent research on the incentives for individual farmers to invest in dairy commercial development and quality improvement offers new some insights into several key behavioral and institutional constraints. Lenjiso (2016) focuses on the intra-household effects of dairy upgrading for labor use, female income

Table 1. Overall household work and dairy time allocation (Matched comparison).

	Dairy marketing		Dairy subsistence		
Outcome Variables	Mean	Std Error	Mean	Std Error	*T*-Stat
Overall working time					
Total household time on work	63.5	0.917	44.7	1.100	13.1***
Men`s time on work	20.5	0.752	13.7	0,776	6.3***
Women`s time on work	43.0	0.680	31.0	0,700	12.2***
Dairy related working time					
Total household dairy labor time	40.7	0.697	22.7	0,648	18.8***
Men dairy labor	14.7	0.507	7. 7	0,405	10.8***
Women dairy labor	25.9	0.490	15.0	0,417	16.9***

Notes: Time is measured over 36 h working period (between 6:00 am to 12:00 pm for two consecutive days), men`s time is the average for joint husband and boy time and women`s time is the average join time for the wife and girl.

***$p<0.01$, **$p<0.05$, *$p<0.10$, $n = 156$ (78 milk market participants and 78 non-participants; 8 households were dropped due to incomplete data).

control, household nutrition, and household investments (in child education) that may result from stronger market orientation. These factors are considered as critical incentives for promoting sustained farm-household investments in dairy upgrading. Dairy production is highly labor-intensive and women and children contribute much of the labor (Feleke 2003; Tangka *et al.* 1999). Smallholder milk market participation involves the adoption of new cattle breeds and improved cattle management skills. These changes affect household labor use and intra-household time allocation. Traditionally dairy was considered as the domain of women. As commercially oriented dairy cattle is kept and fed in the backyards, this raises women`s workload, since animal feeding in the backyard still falls under the women`s domestic responsibilities (see Table 1). Although men also take up a small part of the additional dairy activities, milk income from sales shifts from women to men in participant households. Increased household milk market participation is associated with higher household milk income, but also shifting income control from women to men and an increasing female workload (Lenjiso *et al.* 2015).

Interestingly enough, the female bargaining position within the more commercially oriented dairy households slightly improved (Lenjiso 2016), and dietary diversity and nutritional status of children under five proved to be better guaranteed in commercial dairy households, thus indicating that smallholder market participation has positive effects on food and nutritional security status of farm households in rural Ethiopia. In addition, the willingness to invest in child education also improved among commercial dairy farming households (Lenjiso 2016).

Based on these findings, strategies for farm intensification to improve dairy quality proved to be highly demanding with respect to both capital inputs and (family) labor. In this regard, there are several challenges. First, farmers face

unreliable and unenforceable monthly contract with milk traders and processers. Secondly, rampant information asymmetry in milk markets leads to a higher profit loss for both processers and farmers, particularly during the fasting and wet season. Thus, supporting the provision of long-term contracts with dairy processors (i.e. enhancing price and delivery certainty) and improved access to information and communication services that reduce information constraints within dairy supply chains could certainly support quality upgrading. This implies that the attractiveness and reliability of procurement channels is critical for providing the required incentives toward upgrading of associated input use arrangements and labor use regimes.

We can conclude that upgrading of smallholder dairy production systems requires a balanced and integrated approach where internal and external incentives complement each other. First, strong market-led incentives (e.g. prices based on quality grading) should be in place. External conditions that further contribute to market incentives for dairy intensification are the availability of road infrastructure (lower transport costs) and access to market information (mobile phones) that reduce transaction costs. Second, stable linkages to market outlets and access to improved inputs for increasing quality dairy production are necessary. Improved stall feeding and concentrates are critical for higher quality dairy operations, with shifts to more (exotic) cross-bred animals accompanies the stronger market quality orientation (Duncan *et al.* 2013). The transition from herd size expansion to productivity improvement and better dairy quality is likely to take place once expected returns to investments become better assured and market prospects are guaranteed. Third, opportunities for reliable local institutions and incentives for adjusting intra-household practices need to be guaranteed. For maintaining sufficient market supply of fresh milk (instead of home processing into butter and cheese), local collection networks, and cooperatives linked to dairy processing facilities are of critical importance. Public agencies can support this process with grading and quality certification. Such institutional shifts are vital for enabling dairy producers toward implementing necessary technological shifts (Francesconi and Ruben 2012). Moreover, dairy upgrading should consider implications for intra-household bargaining and the gender distribution of labor and income. It can only be expected to be welfare-increasing if intra-household norms and practices are adjusted and the female bargaining position recognizes their intensified rewards to labor.

5. Consumer demand for dairy products

Milk is a key source of energy, essential amino acids, and micronutrients, particularly needed in less-developed countries, where diets are mainly based on staple grains, pulses, and root crops (FAO 2013; WHO and FAO 2003). Yet, milk is also perishable product and thus a potential threat to food safety and risk for diarrheal diseases, which are major causes of illness and death in developing

Table 2. Households preferred retail format for dairy products (600 households).

	Fluid milk		Butter	
Retail outlet	Freq.	Percent	Freq.	Percent
Modern retail	50	8.4	50	8.7
Dairy shops	218	36.3	56	9.7
Open market	332	55.3	469	81.6
Total	600	100	575	100

Source: Bekele *et al.* (2015).

countries (O'Connor 1995). It is thus important that efforts aiming to increase milk production and productivity in Ethiopia pay full attention to quality management. To understand quality upgrading strategies in the downstream side of the dairy chain, we focus on two aspects: retail outlet choices and product-upgrading strategies.

With regard to retail outlets, Bekele *et al.* (2016a) investigate urban and peri-urban household shopping behavior and retail choice decisions for different types of dairy products in Ethiopia, considering three alternatives: modern retail shops (supermarkets), local specialty stores (dairy shops), and open markets (see also: Francesconi *et al.* 2010). For both fluid milk and butter, open markets are by far the most important shopping location (see Table 2). Even while modern retail outlets in Africa are increasingly accessible to middle-income groups and even poorer segments of the population, the convenience of local shops and the (perceived) freshness of products at the open market still give these outlets a clear comparative advantage. Interestingly, processing only plays a minor role in retail choice: distance, location, cleanness, and reputation are considered as most important factors. Poorer households that have no access to electricity or a refrigerator will make frequent, albeit small daily purchases of fresh milk in local neighborhood shops. Households with more resources tend to shift to supermarket purchases, but still prefer fresh milk from the open market.

To better understand consumer choices for dairy upgrading, several experimental auctions were conducted to elicit their WTP for improved dairy products. Bekele *et al.* (2016a) used real-time consumers' experiment with changes in quality characteristics (taste–nutrition trade-off) to examine whether consumers would appreciate a change in quality characteristics from whole milk to reduced fat milk (Andersen and Smed 2012). A framed market experiment was applied (n = 160 respondents) in selected districts in Addis Ababa city, to compare product characteristics and consumer taste preferences. Result shows that sensory characteristics play a key role in the acceptance of reduced fat milk, but that provision of nutrition information has no significant effect on price premium for reduced fat milk. Furthermore, a substantial percentage of participants showed strong preference for whole milk, while only 19% of the participants expressed a preference for reduced fat milk.

Table 3. Willingness to upgrade and willingness to pay for improved milk products.

	Willingness to upgrade			Willingness to pay		
Type of experiment	Pre-testing stage (%)	Post-Sensory stage (%)	Post-Information stage (%)	Pre-testing stage (%)	Post-Tasting stage (%)	Post-Information stage (%)
Pasteurized vs. raw milk (Bekele *et al.* 2016a)	49	49	64	2.39	2.20	8.08
Whole vs. reduced-fat milk (Bekele *et al.* 2016b)	21	10	28	−14.62	−21.97	−10.14

Notes: In the first experiment, pasteurized milk is the alternative product while raw milk is the baseline product. In the second experiment, reduced-fat milk is the alternative while whole milk is the baseline product. In the second column, the values on willingness to upgrade represent the percentage of people who are willing to upgrade to alternative milk product while in the third column, willingness to pay, the values indicate the increment consumers are willing to pay for improved milk product compared with the baseline product. This was computed by averaging consumers premium values offered for both types of products in that particular stage. A negative coefficient indicates the percentage of consumers discounting the alternative product while positive coefficients indicate the percentage of consumers offering positive premium.

Looking across decisions stages in the auction (see Section 3), Table 3 show that before tasting the product – i.e. only through looking at the type of products – 23% of the participants were willing to upgrade to reduced fat milk, but this number drops to only 10% after participants tasted the two milk products. When nutrition information is provided about the two types of milk products participants changed their valuation. At this stage, the number of participants that are willing to upgrade increased to 28%. This corroborates with earlier findings that found positive effect of nutrition information in quality upgrade decisions (Barreiro-Hurlé *et al*. 2010). Yet, this differs across socioeconomic groups. For instance, differences in age, income, and home-based milk processing influence the WTP for reduced fat milk negatively, implying the presence of heterogeneous preferences and thus the need for segmentation of demand. Regarding the WTP amount, consumers appear to discount for reduced fat milk, but this slightly declines when they are exposed to nutrition information. In this regard, the health conditions of the respondents and their reliance on milk for food preparation increases the price premium paid for reduced-fat milk. In general, this study confirms the existence of a nutrition–taste trade-off. This implies that consumers' responses to changes in quality characteristics of fluid milk tend to be rather limited.

Another analysis refers to consumers'WTP for pasteurized milk, considering that this reduces their food safety risks. Ethiopian consumers prefer raw milk over pasteurized milk for various reasons. They esteem enhanced taste, freshness, more nutrients, and health benefits of raw milk, yet these claims have not been substantiated by independent verification (Claeys *et al.* 2013). Moreover, raw milk is cheap and widely available compared with pasteurized milk (Francesconi

et al. 2010; Yilma *et al.* 2011), and raw milk is accessible to most urban consumers at their door step. Because of health threats of consuming raw milk, consumers in Ethiopia use traditional risk mitigation practices such as boiling raw milk before consumption and making *ergo* (a product that resembles yogurt).

In Ethiopia, raw milk dominates fluid milk consumption and mostly reaches consumers through informal marketing channel. Raw milk is also a major source of food borne pathogens that threaten vulnerable groups such as children and pregnant women. Enhancing demand for pasteurized milk is analyzed through an experiment, where half of the participants are exposed to health information regarding pasteurized milk (Bekele *et al.* 2016a). Table 3 shows that tasting appears to have limited effect in convincing participants to upgrade to pasteurized milk: only half of the participants are willing to upgrade at this stage. Within this group, male and employed participants proved to be willing to shift earlier and pay a 4% premium for pasteurized milk. Otherwise, consumers with more children, higher income, and higher raw milk consumption are less likely to shift to pasteurized milk. Importantly, the result shows that taste is negatively related to consumer's propensity to shift to pasteurized milk. However, health information is an important driver for pasteurized milk adoption that may compensate for taste preferences. Table 3 indicates that 64% of the participants are willing to upgrade to pasteurized milk after being exposed to health information. Among those who upgraded to pasteurized milk, they were willing to pay 8% more compared to the baseline product. Looking at the average of all the rounds, consumers that were provided with additional health information demonstrate their increased WTP a higher price premium for pasteurized milk.

We also analyzed the effect of health and nutrition information on consumer's WTP for improved milk products. When it comes to dairy products, information becomes a credence attribute (related to health) instead of an experience attribute (related to taste) of the product (Grunert 2005). After providing the treatment group with relevant health information, consumers with higher income, older people, and consumers with children were still less inclined to shift to pasteurized milk. In sum, consumer preference for raw milk is mainly the result of taste and perceived nutrition and health benefits, and can only to a minor extent be influenced through pricing. Further, we set up a framed experiment to understand the impact of providing nutrition information label in upgrading to improved fat-modified milk products: reduced fat milk. Consumer's WTP for fat-modified milk products shows that there are a segment of consumers that demand such improved quality products. Yet the effect of nutrition information is limited and differs across segments: educated consumers are more likely to respond to nutrition information.

The existence of such a segmented milk market implies the need for provision of targeted milk market policies. Consumer's WTP for higher quality dairy products might be stimulated through attributes like product information (nutrition facts, expiry rate), packaging, labeling, and branding. Traceability is still of minor

importance but is likely to become relevant if local recognition of the origin of dairy products is lost. Otherwise, household investment for purchasing higher quality or more secure milk might increase if avoidance of health care costs is considered as well. Rising urban incomes are likely to enhance the importance of nutrition and health concerns in household expenditures. But in addition to pricing and availability of upgraded dairy products, the provision of adequate product information is of major importance for enhancing changes in consumer demand.

6. Strategic options

The analysis of farmer's willingness to invest in dairy upgrading and consumers' willingness to buy improved dairy products provides us with relevant information concerning the role of incentives for upgrading food quality in emerging markets. While most studies limit attention to either supply or demand side aspects of quality upgrading, our analysis gives balanced attention to possible opportunities and/or constraints at both ends of the dairy supply chain. This permits to acquire insights into additional actions for aligning product upgrading with social innovation that need to be in place to guarantee the anchoring of value chain transformation.

Quality upgrading needs to be based on key conditions from the supply side that enable smallholder dairy producers and cooperatives to invest time and resources in production system intensification. Therefore, access to improved feed and opportunities for obtaining better cross-breed cows are key technical requirements. It appears, however, that behavioral incentives related to the household time devoted to animal care, the related control over dairy revenues, and the drivers for common action and coordinated supply are critical for engagement in dairy upgrading. This implies that simultaneous changes in the gender decision-making structures at intra-household level and reinforcing the quality control procedures at cooperative level are necessary to safeguard the perspective of inclusive development. Moreover, public investment facilities for upgrading of external infrastructures (feeder roads, dairy collection stations, etc.) and private investments in rural communication (ICT, mobile phone networks) are helpful for reducing transport and information costs (and thus increasing the value added potential). This is also considered of critical importance for enhancing the competitiveness of the Ethiopian dairy sector.

Our findings regarding internal constraints for intensification are in line with the assertion by Fafchamps (2001) that increased engagement in marketing leads in many cases to a shift in intra-household time allocation and gender resource distribution that tends to reduce incentives for quality upgrading. This trade-off is are also confirmed in several other studies conducted in the African context (Kaaria and Ashby 2001; Njuki *et al.* 2011) arguing that in more market-oriented production systems, males easily take control over traditional

women`s products and capture their position in production and marketing once they begin to generate income. The key lesson that can be derived from these analyses is that changes in resource intensification and revenue bargaining are intrinsically linked and that inclusive grading and contract regimes (considering both price and non-price aspects) should be explicitly addressed during the upgrading process.

On the other hand, quality upgrading also needs to respond to emerging consumer demand for improved dairy products, and thus depends on their WTP for higher quality products. Our field experiments indicate that both the presence and convenience of retail outlets can be helpful for developing higher quality-oriented supply chains. Results from the field experiments also show that specific segments of consumers (mainly young, educated, and affluent class) are more willing to upgrade to dairy products with higher intrinsic (better taste) and extrinsic attributes (health and nutrition value). For broader upgrading strategy, access to reliable and trustworthy information regarding nutritional value and health risks of dairy products may influence the purchasing behavior of larger groups of urban households. This, however, requires public investment in quality standards and private investments in processing infrastructure as well as improved packaging, labeling, and advertising (Jaffee *et al.* 2011). Dovetailing such public and private efforts is critical for initiating an inclusive process of quality upgrading that combines technical, social, and institutional change (Klerkx *et al.* 2012). Since supply chain partners alone are not able to address the external constraints that largely determine the supply chain environment (i.e. the hard and soft infrastructure that shape access to markets and information), for a balanced and durable process of dairy market upgrading additional efforts are required to guarantee suitable incentives for inclusion, reliable, and trustworthy value chain interfaces and public awareness and consciousness raising regarding the benefits of improved dairy consumption.

In this regards, public campaigns for awareness raising on the nutrition value of milk (like the iconic 'got milk' campaign in the U.S., 'operation flood' in India or 'the white motor' campaign in The Netherlands) proved to be fairly effective in raising effective demand and increasing the awareness of health and nutrition benefits. Although downstream investments focusing on product appearance and taste involve several supply chain agents, looking holistically to the chain it remains important to start quality improvements at upstream chain level – mainly through better feeding and better breeds, improved farm management techniques, and milk collection centers – in order to synchronize quality upgrading at both ends of the dairy chain. A policy framework should be in place to support cooperatives in improving their milk quality and processing infrastructure through incentives for cooperatives membership, improving milk delivery, and strict quality monitoring systems.

The rapid rise in dairy consumption coupled with higher demand for improved milk quality will continue creating market opportunities for modern

dairy chains in Ethiopia. That places, however, considerable demands for synchronized programs and policies regarding quality upgrading aimed at improving the competitiveness of the whole dairy chain. Dovetailing efforts toward quality upgrading issues requires integrated attention for economic, institutional, and social drivers and needs decisive public and civic action to overcome supply chain trade-offs. Despite our attempt to understand quality upgrading in local dairy chains in Ethiopia, further studies need be initiated on the how governance structures (i.e. power and value-added distribution) and social innovation networks could further reinforce upgrading strategies.

Disclosure statement

No potential conflict of interest was reported by the authors.

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