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Agricultural Value Chains for Food Security and Pro-poor Development

Co-organized by ValueSeC Project and Haramaya University

16-17 December 2016, Haramaya, Ethiopia

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Welcoming and Opening Speech

Dear invited guests,

Distinguished delegates,

Ladies and gentlemen,

It is a great pleasure for me to make a brief opening speech on this very important conference on **Agricultural Value Chains for Food Security and Pro-poor Development** organized by ValueSec project and Haramaya University. Increased agricultural production and productivity is a key towards attaining national food security. This requires to work along the value chain with the value chain actors. In addition to increasing returns from crops and livestock products such as grains, fruits, vegetables, milk, and meat, value has to be added and widely marketed along the value chain. This in turn requires identifying the actors at different levels along the value chain to produce and market efficiently and effectively. To get acceptance by the wider market, the value addition process has to produce a product that meets the expected standards of value adding to agricultural products.

Agricultural producers both at large and smallholder levels need to know how to work with actors and add value to their produce. In this regard, it is necessary to enhance knowledge and awareness of the smallholder farmers and thereby improve their capacity to use technologies required in the value addition process.

I hope this conference would seriously address issues of participation of smallholder farmers in agricultural value chains, benefit shares of smallholder farmers from agricultural production and markets as compared to other value chain actors, bottlenecks and challenges of smallholder farmers, development interventions required for improving involvement and benefits of smallholders, focuses of research and extension services, and capacities required, among others.

Haramaya University has developed a culture of working in partnership and collaboration with various research and development institutions and organizations. Agricultural value chain is among our priority research agenda in this regard. In fact, organizing such scientific forum is among the very important inputs for our triple mandates of teaching, conducting research, and community engagements. As we are aspiring to become a research and postgraduate university, we need to be part of an active wider research community and contribute to the development efforts through the production and distribution of knowledge; and we must involve in research endeavors carried out in partnership and collaboration with funding and sponsorship from non-university sources.

Indeed, it is gratifying to note that the theme of the current conference covers a wide range of interesting topics highly relevant for smallholder farmers for you to attentively follow, comment, enrich, share ideas, and engage in thoughtful scientific dialogue. In addition, I feel that the conference provides adequate opportunities for researchers to share the information they generated on agricultural value chains and food security through rigorous research. This is because undertaking a research by itself cannot be an end, if the outputs are not adequately and timely shared to the users and policy makers.

I thank the ValuSec (Value Chain Development for Food Security in the Context of Climate Change) project and the organizing team of the conference. Finally, I wish you a very pleasant stay here at Haramaya with productive and successful deliberations during the two days. With this brief remark, I declare the workshop is officially opened.

I thank you!

Chemeda Fininsa (Professor)
President, Haramaya University
16 December 2016

1. Making Value Chain Development to Work for the Poor

Bezabih Emana

HEDBEZ Business & Consultancy PLC. (www.hedbez.com)**, E-mail: emana_b@yahoo.com**

1. Why Value Chain Approach?

Value chain approach increases efficiency and effectiveness of business functioning. Increasing the competitiveness of the firm is only effective at sustainably creating wealth and alleviating poverty when the competitiveness of the industry is similarly raised by interventions at all levels of the value chain. It is important to note that globalized market requires efficiency and competitiveness at firm and industry levels in the following aspects:

- Efficient forms and quality products and services demanded by consumers;
- Efficient delivery methods and time;
- Competitive price
- Sustainable services

Value chain is featured by the functional structure, motivation in market participation or value chain development by end market demand, business enabling environment, linkages, support service providers, governance and value chain upgrading. These are briefly elaborated below:

i) *Value chain structure*: The structure shows the functional links between value chain actors starting from input suppliers to producers, traders, processors through consumers (Figure 1).

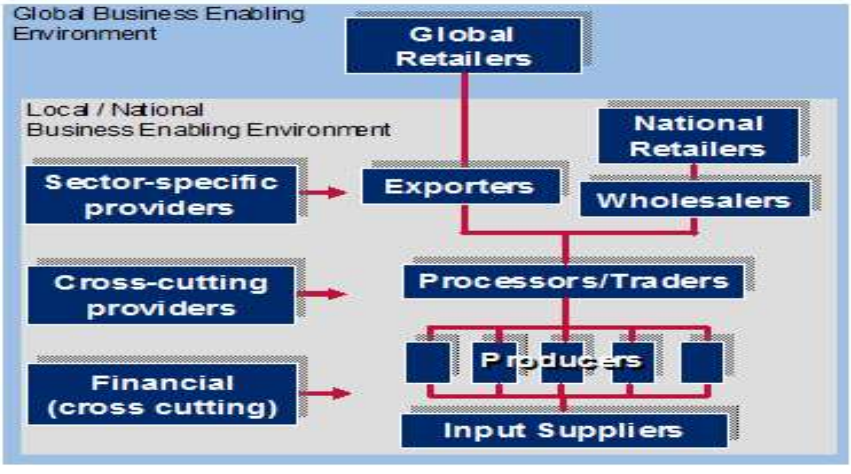

Figure 1. Value chain structure.

Source: https://www.microlinks.org/good-practice-center/value-chain-wiki/value-chain-analysis.

ii) *End Market:* The end market is a starting point for value chain analysis. It is about people who consume the goods and services, not location. End market assessment is about assessing what people need. It includes current and potential demand;

identifying the potential for VC upgrading, involves determining the characteristics-including price, quality, quantity and timing—of a successful product or service. End market buyers are a powerful voice and incentive for change.

iii) *Business Enabling Environment:* Chains operate in a business enabling environment at global, national and local levels. The business environment includes norms and customs, laws, regulations, policies, international trade agreements and public infrastructure (roads, electricity, etc.). It determines relationships, agreements and market standards.

iv) *Integration:* A value chain structure involves vertical and horizontal linkages. Vertical value chain linkage bounds linkages between value chain actors at different levels of the value chain. Vertical linkage enables smooth flow of a product or service to the end market. Vertical cooperation reflects the quality of relationships among vertically linked firms up and down the value chain. In a value chain analysis is relevant for identifying missing/weak links and requires assessment of who plays what role in a value chain.

Horizontal Linkage is a linkage between firms at all levels in a value chain aiming to reduce transaction costs, create economies of scale, and contributes to the increased efficiency and competitiveness of an industry. In addition to lowering the cost of inputs and services, horizontal linkages can contribute to shared skills and resources and enhance product quality through common production standards.

Horizontal Linkages facilitate collective learning and risk sharing, while increasing the potential for upgrading and innovation and ensures competition between firms. While cooperation can help firms achieve economies of scale and overcome common constraints to pursue opportunities, competition can encourage innovation and drives firms to upgrade. Cooperation among small scale producers help to reap the benefit of horizontal linkage

v) Support Service Providers:

- Include financial services; cross-cutting services such as business consulting, legal advice and telecommunications; and sector-specific services, for example, irrigation equipment or handicraft design services.
- Value chain actors need supplies, training and financing in addition to strong vertical and horizontal linkages.
- Play an important role in firm upgrading.
- Value chain analysis should therefore seek to identify opportunities for improved access to services for target value chain.

vi) Value Chain Governance:

- Value chain governance refers to the relationships among the buyers, sellers, service providers and regulatory institutions that operate within or influence the range of activities required to bring a product or service from inception to its end use.
- Governance is about power and the ability to exert control along the chain – at any point in the chain, some firm (or organization or institution) sets and/or enforces parameters under which others in the chain operate.

vii) Upgrading:

- In order to respond effectively to market opportunities, firms and industries need to innovate to add value to products or services and to make production and marketing processes more efficient.
- Upgrading leads to higher returns and a steady, more secure income through the development of knowledge and the ability to respond to changing market conditions.
- Upgrading at the industry-level focuses on increasing the competitiveness of all activities involved in the production, processing and/or marketing of a product or service and mitigating the constraints that limit value chain performance.
- Upgrading needs to be a continual process and can leads to national economic growth from which the poor also benefits.
- Process upgrading: increasing the efficiency of internal processes such that these are significantly better than those of rivals, both within individual links in the chain
- Product upgrading: introducing new products or improving old products faster than rivals
- Functional upgrading: increasing value added by changing the mix of activities conducted within the firm
- Chain upgrading: moving to a new value chain.

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- *Process upgrading*: increasing the efficiency of internal processes such that these are significantly better than those of rivals, both within individual links in the chain
- *Product upgrading*: introducing new products or improving old products faster than rivals
- *Functional upgrading*: increasing value added by changing the mix of activities conducted within the firm
- *Chain upgrading*: moving to a new value chain

2. Challenges in Integrating Smallholders to Value Chain Development

2.1. Features of Production

Several factors hinder integration of smallholder farmers in value chain development. These include:

i) Production of subsistence crops and small farm size. Smallholder farmers engage in the production of low value crops. The largest proportion of farmers produces cereals. The proportion of the producers decline as the crop type shifts to high value crops (Figure 2).

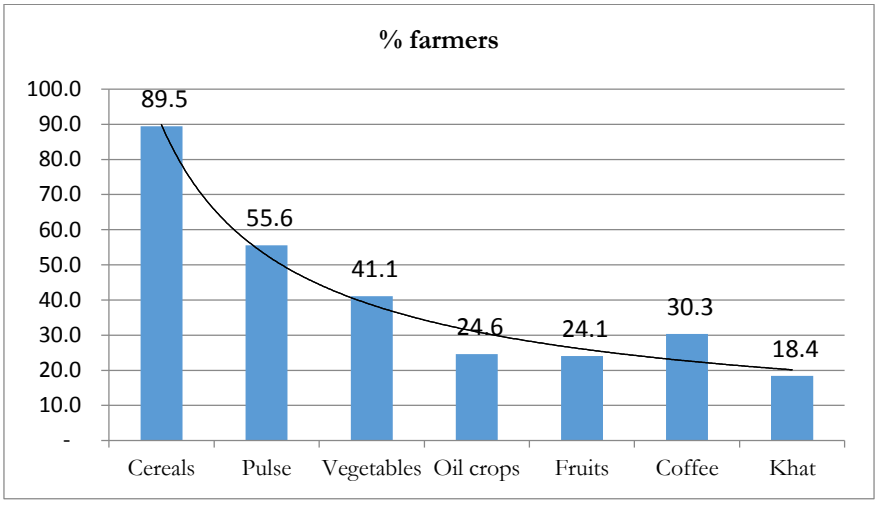

Figure 2. Proportion of farmers growing crops in Ethiopia during 2013-14 meher season.

Source: CSA (2014).

Cereals, which are also of relatively low value, dominate in the land allocated for crop production (Figure 3). It is also clear that land under crop is small (< 1 ha) and the larger portion of the land is allocated to cereals, relatively low value. Land matters for increasing production of sufficient quantity for value chain integration. Overall, area under cereal crops, which are largely grown for subsistence, dominates the cropping system. Production is merely enough for subsistence.

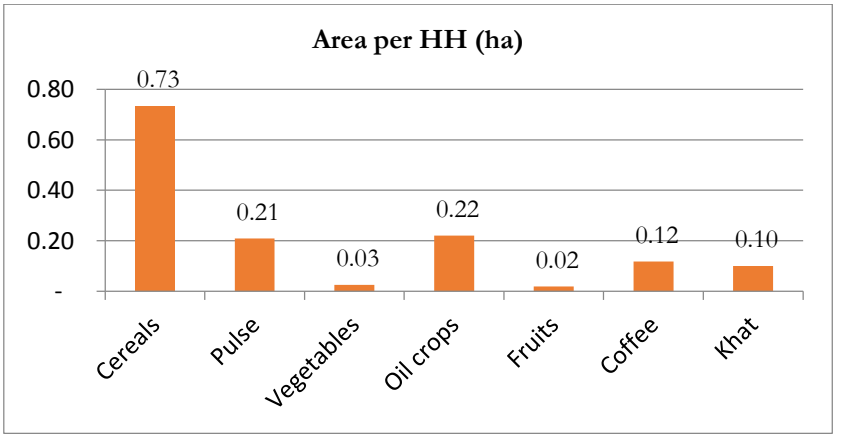

Figure 3. Average area under crops in Ethiopia during 2013/14 meher season.

Source: CSA (2014).

ii) Fragmentation and disperse setting: crop farming is fragmented and crops are produced on small parcels. This creates difficulty in application of machineries such as harvesters to timely collect grain. Disperse household location in diverse and remote geographic locations makes market linkage difficult. Lack of infrastructure also worsens the access to market problem.

iii) Attitude and business knowledge (management): The majority of the smallholders produce crops with the main objective of meeting subsistence. The attitude of producing competitive crops for income generation even if the income can be used for accessing food from the market. Limited knowledge of value chain development and the subsistence behavior creates challenges to participation of smallholder farmers in value chain development.

iv) Low productivity: Crop yield in Ethiopia is generally low and the trend in yield increment is stable at lower level. Compared to the yield of wheat in Egypt, the yield of wheat in Ethiopia is three fold lesser (Figure 4).

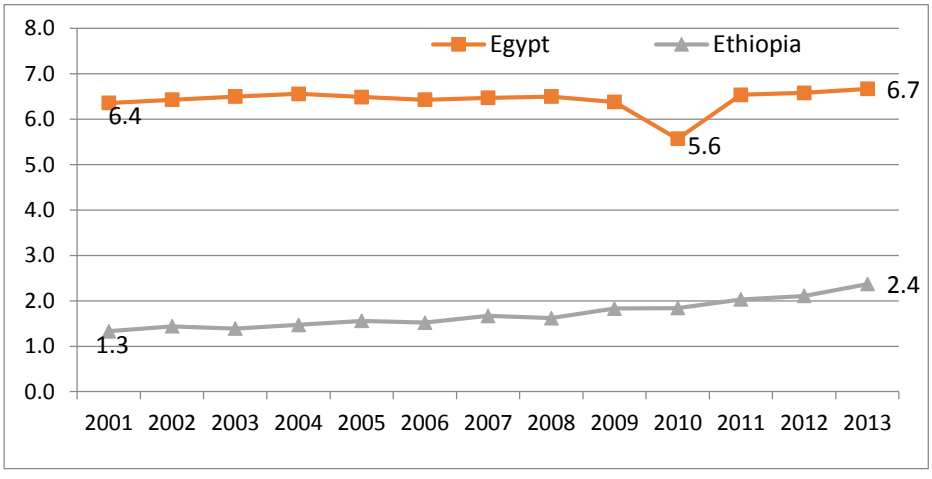

Figure 4. Comparison of wheat yield in Egypt and Ethiopia (ton/ha).

Source: Compiled based on (FAOSTAT) data (2001-2013).

The high wheat yield level in Egypt is innovation in seed, which is determinant of response to other factors and use of irrigation technologies. Crop management is also of high level.

2.2. Why Low Yield or Production in Ethiopia?

Production is a function of area and yield. Obviously the largest farming population in Ethiopia operates small and fragmented land size with an average of less than 1 ha. Some of these farmers may never produce surplus to feed the non-agricultural sector. Increased yield would enable such small farmers to feed their families or narrow their food gaps while it enables the larger farmers to produce surplus to feed the non-farming population and the processing sector.

Yield is also affected by many factors. Erratic rain which is becoming common in Ethiopia and beyond due to climate change is making the agricultural sector vulnerable. The yield potential of improved seeds, number of farmers using them, size of land allocated to improved seeds and the package of associated inputs such as fertilizer, chemicals, irrigation water and farm management practices determine the yield level. The

proportion of farmers using improved varieties of crops stood at 22.9% where only 8.4% of the cropland is covered by improved crop varieties (Figure 5). Irrigation water is the least used yield increasing input where only 8.6% of the farmers used and only 1.3% of the cropland is irrigated. Fertilizer is the most commonly used yield increasing commercial input where about 80% of the farmers used it and about 47% of the cropland is covered with fertilizer (Figure 6). This implies that part of the fertilizer is used for local seeds and with incomplete package and hence resulting in below potential yield. Higher interest for use of fertilizer has been triggered by declining soil fertility and increasing soil degradation.

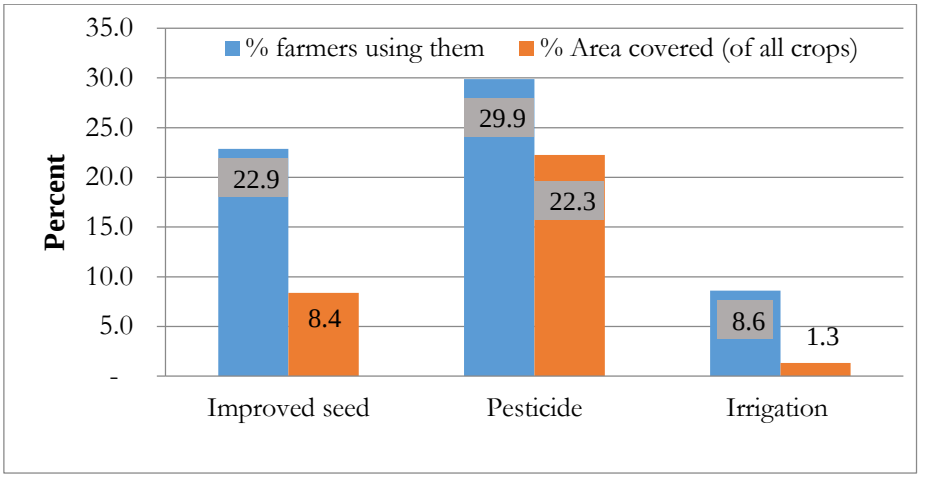

Figure 5. Proportion of farmers using selected yield increasing inputs in Ethiopia and area covered (%) during 2013/14 meher season.

Source: CSA (2014).

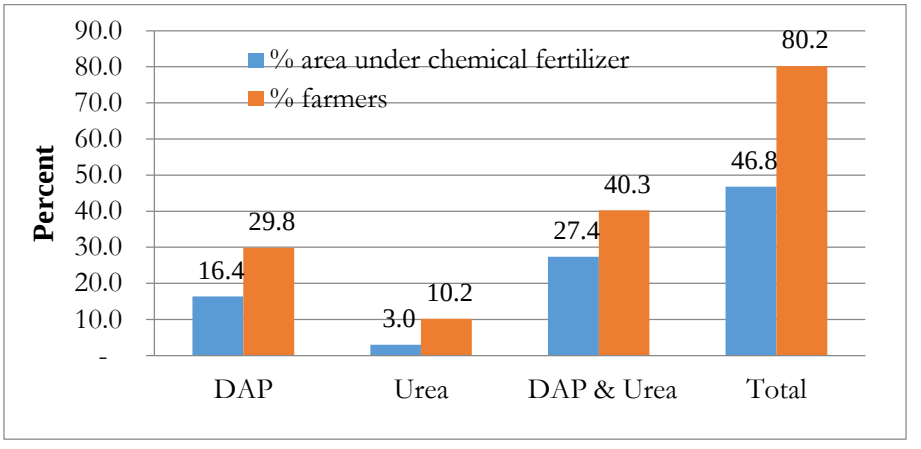

Figure 6. Proportion of farmers using fertilizer in Ethiopia and area covered (%) during 2013/14 meher season.

Source: CSA (2014).

Considering wheat and maize varieties, corps for which improved varieties are largely available, the proportion of farmers using improved varieties and associated yield increasing inputs is extremely low. As shown in Table 1, about 27% and 1.7% of maize and wheat producers, respectively, used improved varieties and irrigation is not a

common input for maize and wheat production. About 23% and 34% of the maize and wheat producers, respectively, used fertilizer in 2012/13. But the intensity of fertilizer use is below the recommended rate of 100kg urea and 100kg DAP.

Table 1. Farmers using agricultural technologies and land covered by the technologies (%).

	Improved seed	Pesticide	Irrigation		All fertilizer	Average use (kg/ha)
Maize				Maize		
Farmers	27.6	5.0	2.9	Farmers	22.6	
Area covered	40.0	5.7	1.4	Area covered	69.1	83.4
Wheat				Wheat		
Farmers	1.7	36.6	0.9	Farmers	33.8	
Area covered	10.2	47.2	0.4	Area covered	77.9	101

Source: CSA (2012-2013).

Essential question is why low adoption rate and what factors are associated with this problem. The problems may be associated with low popularization of the technologies, input supply constraint, input and out market imperfection, affordability, or poor extension system. Social science research in general and agricultural economics and extension research in particular should be responsible to look into these systemic and institutional issues to lead agricultural productivity and production growth and contribute to realization of the vision of the country to leave poverty and hunger behind it.

3. Possibilities for Developing Pro-poor Value Chain

Despite the factors stated above which limit smallholders' involvement in value chain development, the following interventions enable overcoming the constraints to participate in value chain development:

i) *Increasing supply*: Agricultural output supply to the market is enhanced by producing surplus. This is possible through alternative means such as intensification of production or increasing the scale of production through a more consolidated or clustering of land which enables use of modern agricultural technologies such innovations in production systems, improved crop management, high yielding inputs, mechanization technologies, etc.

Upgrading skill and attitudes of farmers to consider farm as business is essential condition for commercialization of smallholder farms. Attitudinal change in terms of understanding "no profit without investment; no sustainability without ownership" and reducing the tendency to rely on external forces as major supplies of factors for increased supply, and instead take on concerted effort to access and use these inputs. It also involves producing gain and seed to make money not just for subsistence rather than engaging in production of only low value crops.

ii) *Agro-processing*

iii) *Trade, warehousing, distribution*

4. Strategy for Value Chain Upgrading for Smallholders

Based on the context of smallholder farmers in Ethiopia, there are four major means of upgrading value chain for stronger participation of smallholder farmers:

i) **Horizontal collaboration among farmers:** Clustered seed production; grain production; milk collection centers, etc.

ii) **Vertical collaboration:** involves hierarchical organizational links between member farmers, primary cooperatives, unions, traders/processors and other value chain actors. The potential to use cooperative development for higher participation of smallholders in value chain development is high. Table 2 shows the extent of cooperative organizations in Ethiopia.

Table 2. Cooperatives in Ethiopia in 2013/14.

Items	Number	Remark
Primary cooperatives	56,044	32 types
Total members	9,165,267	
Male	6,949,589	
Female	2,215,678	24.17%
Capital (Birr)	8.76 billion	
Capital per coop (Birr)	156,227	
No. of unions	7412	13%
No. of members	2,840,370	31%

Source: Compiled from data from Federal Cooperative Agency, Addis Ababa.

Some unions involve in improved seed production and market, most unions distribute fertilizers, chemicals and machinery services to their members. Some unions have engaged in agro-processing and export of agricultural products. If the market link and problem of lack of value chain partnership is overcome, the potential for engaging more farmers in value chain development in Ethiopia is high.

iii) **Investment in knowledge, innovation for development/change, and system** is instrumental for changing farmers' attitude towards profit oriented business farming vis-a-vis subsistence farming.

iv) Think of **co-investment** by all involved – public and value chain actors. Smallholder farmers' ownership of the value chain can be enhanced by allowing them to contribute to value chain development in kind.

There are different development programs implemented by the government and NGOs to enhance farmers' market participation to improve their livelihood. The impacts of such intervention depend on:

- Programs and projects targets – smallholders? Poor? Women? etc.
- Holistic in addressing critical challenges and opportunities- understanding of the opportunities and constraints along the value chain and adequate intervention to overcome constraints and exploit the opportunities.
- Land tenure system seems crucial- fragmented and very small land size constrains increased production.
- Adequacy and efficiency of the support system – innovation, policies, credit, extension, infrastructure, storage and transport facilities, etc.

It is also apparent that not all poor engage in value chain development. Nationally, the system should enable the poor to benefit from the value chain development by creating opportunities for the poor to access employment and generate income so that the poor can get its share from the economic growth.

v) **Entry-points for Upgrading:** The entry points for value chain development can be initiations by or through farmers and their organizations; processors and traders; lead companies; and business development - and financial services.

vi) Issues that need further exploration

- Enabling environment.
- Several isolated value chain studies available – translation of the knowledge into action to comprehensively guide value chain development.
- Transformation into value chain development requires more efforts- confidence in value chain actors, trust, resources and alternative and efficient markets.
- The value chain actors, not initiated the value chain analysis – ownership as business sense of the analysis
- Poverty, gender and value chain development linkage not yet rigorously be done.

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2. Determinants of Producers', Market Outlet Choices of Gesho (*Rhamnus prinoides*) in Central Tigray Regional State, Ethiopia

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Abstract: This study was aimed to analyze producers' market outlet choices and its determinants in Ahferom district in Central Zone of Tigray Regional State of Ethiopia. Descriptive analysis and simulated maximum likelihood (SML) multivarite probit model were employed to analyze the data.The simulation results suggest that households' had three major market outlet choices (farmer traders, wholesalers, and direct consumers), and separate estimation of choice of the three outlets was biased since the choice decisions were interdependent and simultaneous. The joint probability of choosing all the three outlets was 12.2 percent and the probability of failure to the three outlets was only 2.8 percent. The results indicate that smallholder farmers choose at least two outlets at a time. The choice of producers on the three outlets was determined by similar underlying factors. Extension service, lagged price, and distance to district market were crucial determinants of outlet choices of producers. Therefore, efforts to improve and widen the provision of extension services and to improve road infrastructure facilities are very crucial. Moreover, concerned organizations need to conduct integrated institutional services to maximize the utility of smallholder farmers.

Keywords: *Rhamnus prinoides* (Gesho); multivarite probit model; Ahferom; simulation.

1. Introduction

Rhaminus prinoides, with the local name '*Gesho*', is a dicotyledonous angiosperm plant cultivated in Ethiopia. It is a shrub or tree which grows up to 6 meters and is also known to occur in Ethiopia, Botswana, Eritrea, Lesotho, Namibia, South Africa, Swaziland, Uganda, Kenya, Cameroon, Sudan, and Angola (Digafie, 2010).

Ethiopian's *gesho* is one of the homestead cash perennial trees, mainly grown in Tigray Region, North Shoa of Amhara Region, Kara Kori and Sebeta of Oromia Region and Hadya Zone of Sothern Nations, Nationalities and Peoples (SNNP) Region. It is used for domestically brewed beverages such as *Tella* and*Tej*; it has several medicinal values; and it is required for modern brewery in Ethiopia and other African countries (Afework and Bhagwan, 2012).

In Tigray Region, *gesho* is a good source of income for rural households. In the region, there are significant numbers of women whose livelihood are dependent on processing *Tella.* Besides, due to the similarity of Ethiopian and Eritrean cultures and religions, it was highly tradable item to Eritrea before the Ethio-Eritrea conflict and it is traded via Sudan after the conflict. This implies that it is a potential item for export to countries which have similar socio-cultural values thereby generating foreign earnings (OoARD, 2014).

In Ahferom district, most of the rural households are cultivating *gesho* and it is considered as the main cash perennial tree and main stay of livelihood (Afework and Bhagwan, 2012). In the district, many smallholder farmers were engaged in *gesho* production and 19,480 quintals of *gesho* were produced in the 2014/15 production year (OoARD, 2014). It was reported that many traders were engaged in *gesho* exporting activities, and a total of 4571 quintals of *gesho* were exported from Humera to Sudan in the year 2014/15 (HCRA, 2014). However, wholesalers were the dominant outlet choices that producers forced to choose this channel due to oligopolistic nature of the market structure in the study area.

Moreover, income and employment contribution of *gesho* tree for the society, particularly for women and the rural economy, had not been researched; *gesho* producer's outlet choices and determinants have not been identified and addressed. Therefore, the main purpose of this study was to identify farmers' market outlet choices and its determinants in the study area.

2. Research Methodology

2.1. The study area

Ahferom District (Figure 1) is found in Central Zone of Tigray Regional state. It is located between 14^0 06' 30" to 14^0 38' 30" North in latitude and longitudinally from 38^0 56' 30" to 39^0 18' East. It is characterized by high population, rugged topography dominated by mountains and mixed farming system with small cultivated land, and intercropping *gesho* with cereals (ARDOoAD, 2014).

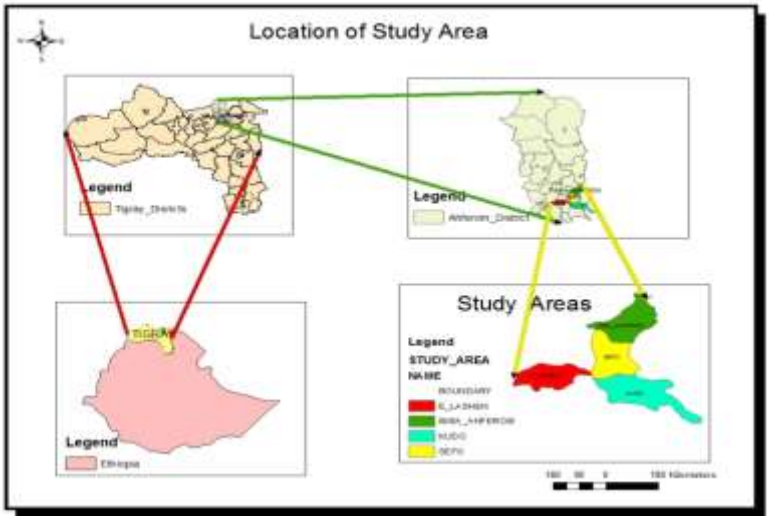

Figure 1. Geographical location of the study area.

2.2. Dataset and methods of analysis

Multi-stage sampling procedure was used to select sample *gesho* producer kebeles (the lowest administrative unit in Ethiopia) and smallholder producers. In the first stage, in consultation with the district agricultural experts and development agents, out of 27 rural kebeles, 15 *gesho* producing kebeles were selected purposively based on the actual level of production. In the second stage, four sample kebeles were selected randomly. In the third stage, 132 sample households were selected randomly from the lists of *gesho* producer kebeles.

For identifying the determinants of outlet choices, multivariate probit (MVP) model was used. MVP is a generalization of the probit model used to estimate several correlated binary outcomes. It is used to estimate the effect of independent variables on a dependent variable involving multiple choices with unordered multiple categories (Gbetibouo, 2009). Therefore, this model simultaneously captures the influence of the set of explanatory variables on each of the different channel choices, while allowing the unobserved and/or unmeasured factors (error terms) to be freely correlated.

The household decision of whether or not to choose a given channel is considered under the general framework of utility maximization. In this context, the utility of the economic agents is not observable, but the actions of the economic agents could be observed through the choices they made. Therefore, MVP model by a set of m binary dependent variables y_{hpj} is specified as:

$$y^*_{hpj} = x'_{hpj}\beta_j + U_{hpj}, \qquad j = 1, 2, \ldots . m. \tag{1}$$

$$y_{hpj} = \begin{cases} 1 \; if \; Y^*_{hpj} > 0 \; (if \; the \; farmer \; choose) \\ 0 \; otherwise \end{cases} \tag{2}$$

Where $j = 1,2, \ldots m$ denote the market outlet choices available; x'_{hpj} is a vector of explanatory variables, β_j denotes the vector of parameters to be estimated, and U_{hpj} are random error terms distributed as multivariate normal distribution with zero means and variance–covariance matrix V. Where V has values of 1 on the leading diagonal and correlations jm = mj as off-diagonal elements.

The potential factors determining market outlet choices are hypothesised to be age, sex, and educational level of the household head, distance to the nearest market, livestock holding, extension contact, lagged price of gesho, membership in a cooperative, access to market information, access to non-/off-farm income, and price negotiation (Table 1).

Table 1. Summary of variables used in the MVP model.

Variables	Type	Measurement
Age of household head	Continuous	Years
Sex of household head	Dummy	1= male,0=female
Educational level	Continuous	Years of schooling
Distance to district market	Continuous	Hours
Livestock ownership	Continuous	Tropical Livestock Unit (TLU)
Number of extension contact	Discrete	Number of contact per year
Lagged price of *gesho*	Continuous	ETB
Membership in cooperative	Dummy	1= yes,0= no
Access to market information	Dummy	1=have,0= no
Income from non/off-farm	Dummy	1=have,0= no
Negotiation	Dummy	1=have,0= no

3. Results and Discussion

3.1. Household Characteristics

Of the total 132 interviewed *gesho* producing households, 74.2% were male and 25.8% were female headed households. The mean age of sample household heads was 48 years. The average family size of sample households was 5.6. The illiterate household heads were 26% while the remaining 74% of the sampled households had different level of education, which ranges from reading and writing up to completion of grade 12. The average land size owned per sample households was 0.55 ha and average land allocated for *gesho* production was 0.18 hectare.

Gesho is the main ingredient of local brewery and common marketed produce in the study area. The most valuable parts of the tree is its leaves and it is harvested two to three times a year. The average number of *gesho* tree per sample households was 68 (Table 2). The average volume of *gesho* produced by sampled households was 262 kg per year. Out of the total quantity produced 94% was supplied to the market and the rest 6% was consumed at home in the form of different local beverages for ceremonies. Farming system of the study area was mixed crop-livestock. Crops are grown for subsistence food, and livestock are kept for complementary purpose and to support farmers' cash needs. Intercropping of *gesho* with cereal crops is the main cropping system in the study area. The major annual crops grown by the respondents in the study area were wheat, barley, bean, lentil and *hanfets*.

Table 2. Gesho production and market supply in the sample households.

Variable	Mean	Standard Deviation
Number of *gesho* trees	68.03	51.08
Average product per tree in kg	1.68	1.01
Harvesting frequency per year	2.50	0.53
Gesho produce in kg	262.38	185.64
Gesho market supply in kg	246.72	161.21

Source: Survey results (2016).

3.2. Market Outlet Choices of Gesho Producers

The major marketing outlets were identified and characterized by many intermediaries along the value chain as illustrated in Table 3 below. There are three major market outlets chosen by gesho producers: farmer traders, wholesalers, and consumers. Large number of farmers choose wholesalers, followed by farmer traders, and direct consumers, respectively. Of the total volume of *gesho* supplied by sample households, 34.9%, 56.1% and 9% were sold to farmer traders, to wholesalers, and direct to consumers marketing outlet, respectively.

Table 3. Producers' market outlet choices and volume of supply to each outlet.

Market outlets	Producers' choice	Supply of *gesho* (kg)			
	Frequency (N)	Total	Mean	Percent	SD
Farmer traders outlet	87	11,365.88	130.64	34.9	99.46
Wholesalers outlet	90	18,270.08	203.00	56.1	163.79
Direct consumers outlet	42	2,931	69.785	9	62.054
Total	132	32,567	246.72	100	

Note: N- Number of observations, SD- Standard deviations.

Source: Survey results (2016).

3.3. Determinants of Market Outlet Choices

In the multivariate probit model outputs, the samples were drawn 100 times (Table 4). The matrix rho_{21}, rho_{31}, rho_{32} represented the correlation coefficient matrix between farmer traders and wholesalers, direct consumers and farmer traders, direct consumers and wholesalers, respectively. The likelihood ratio test result indicated that the correlation coefficients are statistically different from zero in one of the three cases, confirming the appropriateness of the multivariate probit specification, and outlet choices are mutually interdependent. The Wald $\chi 2$ test value of 72.4, which is significant at 1% level, indicated that separate estimation of choice of these outlets is biased and the decisions to choose the three outlets were interdependent.

The null that the tetrachoric correlations are jointly zero and the three outlet choice decisions are independent was rejected at the 1% level. The simulated maximum likelihood (SML) estimation results suggested that there was a negative and significant interdependence between household decisions to choose farmer traders outlet choice and wholesalers at 1% significance level, and wholesalers and direct consumers outlet choice were also negatively and significantly interdependent at 10% significance level, but not between farmer traders outlet and direct consumers.

The choice of farmer traders' outlet significantly decrease the choice of wholesalers' outlets, since the households' decision to choose one type of outlet reduces choice of the other outlets. The outlet choice of farmer trader was influenced by age of the household head, extension contact, average lagged price, and distance to district market and membership to cooperative. Distance to district market, sex, extension contact, lagged price and age of household head were significant determinants of the wholesalers' outlet choices. Direct consumers market outlet was also negatively and significantly affected by livestock ownership and distance to district market and it is positively affected by extension contact and lagged price.

The likelihood of gesho producers to choose wholesalers, farmer traders, and consumers was 68%, 65%, and 31%, respectively. Producers are more likely to sell their produce to wholesalers followed by farmer traders. Direct consumers purchase small volume of produce in the district market and hence, are less preferred by producers.

The joint probability of producers to choose all the three outlets simultaneously was less likely (12.2%). This was due to the fact that all the three outlet choices were simultaneously accessible in the study district by the smallholder farmers. Besides, the three outlet choices were competitive. However, the joint probability of failure to choose all the three outlets was unlikely (only 2.8%). The results generally verify that gesho producers prefer to sell their produce to wholesalers and farmer traders.

Table 4. Model outputs of multivariate probit for determinants of outlet choices.

Variables	Farmer traders		Wholesalers		Direct consumers	
	Coefficient	S.E	Coefficient	S.E	Coefficient	S.E
Age	0.029***	0. 011	-0.023**	0. 011	-0.004	0.011
Sex	-0. 177	0. 333	0. 598**	0. 303	-0.164	0. 295
Education	-0. 022	0. 036	-0. 043	0. 037	0.037	0. 037
Distance	-0.05*	0. 03	-0.07**	0.03	-0. 09***	0.03
Off-farm income	0. 065	0. 357	-0. 376	0. 340	0. 387	0. 336
Livestock (TLU)	0. 007	0. 123	-0. 149	0. 105	-0.292**	0. 115
Market info.	-0. 336	0. 363	0. 416	0. 343	-0. 161	0. 318
Extension	-0.025*	0.015	0. 05***	0. 014	0. 038***	0. 014
Coop membership	-0. 808**	0. 360	0. 307	0. 365	0. 020	0.347
Negotiation	-0. 341	0. 269	0. 078	0. 256	-0.040	0. 261
Lagged price	-0. 148***	0.044	0.135***	0. 042	0. 077**	0. 036
Constant	4.182	1.837	-2.214	1.717	-1.778	1.547
Rho_{21}		-0. 63***				
Rho_{31}		0. 125				
Rho_{32}		-0.244*				
Predicted probabilities		0.65			0.31	
			0.68			
Joint probability (success)		0.12				
Joint probability (failure)		0.028				
Observations		132				
Number of simulation (draws)		100				
Log likelihood		-204.72				
Wald $Chi^2(33)$		72.36				
Likelihood ratio test of $rho_{21} = rho_{31} = rho_{32} = 0$; $Chi^2(3) = 15.73$***						

*Note: Dependent variable is market channel choices, S.E – Standard Error, ***, ** and * are statistically significant at 1%, 5% and 10%, respectively.*

Source: Authors' computation (2016).

4. Conclusion and Recommendations

The empirical evidence in this paper suggests that it was more likely for households to choose at least two outlets simultaneously. This was due to the fact that all the three outlet choices were simultaneously accessible in the study district by the smallholder farmers. Besides, the three outlet choices were adversely affecting each other owing to the fact that they are competitive in the market. Therefore, efforts are needed to promote producers to choose wholesalers and direct consumers outlet since they enable them to get premium price margin.

It is apparent that the choice of producers on the three outlet choices was determined by similar underlying factors. The result of multivariate probit indicated extension service, lagged price, and distance to the district market were crucial determinants of outlet choices. Therefore, efforts are needed to enable producers to get well organized extension services and better transport facilities. Moreover, concerned institutions need

to offer an integrated institutional service that maximizes the utility of smallholder farmers.

5. Acknowledgements

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3. Determinants of Milk Market Outlet Choices in Soddo Zuria District, Wolaita Zone of Southern Ethiopia

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Abstract

This study was undertaken with the objective of identifying marketing channels and assessing factors affecting milk marketing channel choices by smallholder dairy farmers in Sodo Zuria district of SNNPR, Ethiopia. Using farm household survey data collected from 120 households, milk market outlet choices were analyzed using multivariate probit model. The preliminary analysis indicates that the major channels identified in the study area were small milk traders', hotels, and individual consumers' marketing channels with their share of 9%, 34.9% and 56.1%, respectively. Multivariate probit model outputs revealed that educational status of household heads, number of milking cows, proximity to urban center, total land holding, extension service, family size, and sex of household head significantly and positively determined channel choices of farmers. Moreover, the model result depicted that the predicted probability of choosing small traders channel was 39.3% which is relatively lower than individual consumers (52.8%) and hotels (52.4%). The likelihood of producers to jointly choose the three channels was 33.2% and their probability of failure to choose all the channels was 10.1%. As one of the key factors to boost milk market outlet choices, dairy extension services should be strengthened through redesigning or reforming implementation strategies or improving/strengthening existing policy. Moreover, government needs to strengthen milk processing cooperatives and improve marketing infrastructural facilities.

Keywords: Market participation; supply; market outlet choice; multivariate probit; Soddo Zuria

1. Introduction

Ethiopia is one of the Sub-Sahara African countries with a large potential in livestock, being the top among African countries and ninth in the world. Dairying is one of the livestock production systems practiced in almost all over the world including Ethiopia, involving a vast number of small, medium, or large-sized, subsistence or market-oriented farms. Dairy production systems in Ethiopia are classified based on climate, land holding and integration with crop production. Pastoralist, highland smallholder, urban and peri-urban, and intensive dairy farming systems are recognized in Ethiopia. The rural dairy systems, which include pastoral, agro-pastoral, and mixed crop–livestock systems contribute 98% and the peri-urban and urban dairy systems contribute only 2% of the total milk production of the country (Sintayehu *et al.*, 2008).

Dairy production contributes to the livelihood of the owners as important sources of food and income. Dairying is practiced almost all over the country though the potential is not yet fully exploited. In Ethiopia, in terms of regional distribution, the Southern Region has the largest dairy cows' population, closely followed by the Oromia region and with the Amhara region (CSA, 2012).

In spite of such a substantial potential, the dairy sector is not developed to the expected level. The annual growth rate in milk production of 1.2 percent falls behind the annual human population growth estimated at 3 percent (CSA, 2012). The low productivity of the country's' livestock production system in general and the traditional dairy sector in particular is mainly attributed to shortage of cross-breed dairy cows, lack of capital by dairy producers, inadequate animal feed resources both in terms of quality and quantity, unimproved animal husbandry systems, inefficient and inadequate milk processing materials and methods, low milk production and supply to milk processing centers and poor marketing and market information systems.

In 2010, less than seven percent of the annual milk production was estimated to be marketed at national level. In most of the cases, existing dairy cooperatives are operating in areas that are accessible to transportation and markets. This means that a substantial amount of milk does not reach the markets and a number of producers keep on producing at a subsistence level. Sodo Zuria District is located in the Southern part of Ethiopia where the largest dairy cows' population is found and the climate condition is also favorable.

2. Methodology

2.1. Description of the Study Area

Sodo Zuria is one of the districts in the Southern Nations, Nationalities, and Peoples (SNNP) Region of Ethiopia. It is part of the Wolaita Zone, and bordered on the southwest by Offa, on the west by Kindo Koysha, on the northwest by Damot Sore, on the north by Boloso Sore, on the northeast by Damot Gale, on the east by Damot Weyde, and on the southeast by Humbo. The district also contains 30 kebeles. Based on the 2007 Census conducted by the CSA, this district has a total population of 162,691, of whom 80,002 are men and 82,689 women; none of its population is urban dwellers. The majority of the inhabitants were Protestants, with 66.67% of the population reporting that belief, 26.83% practiced Ethiopian Orthodox Christianity, and 5.28% were Catholic.

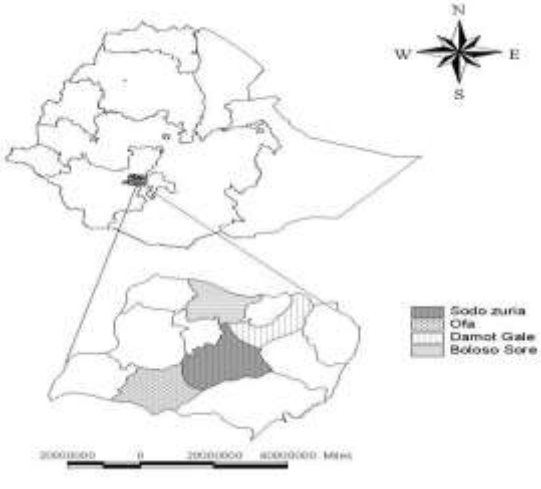

Figure 2. Location of the study area.

Source: Sodo Zuria District Administration Office.

The area is divided into three ecological zones: *Kola* (lowland <1500m), *Woina Dega* (mid-altitude 1500-2300m) and *Dega* (highland > 2300m). Most of the area lies within the mid altitude zone. Rainfall is bimodal, with an average amount of about 1000mm (lower in the lowlands and higher in the highlands). Mean monthly temperature vary from 260C in January to 110C in August. Soils (mainly Vertisols and Nitosols) vary in pH from 5-6. Primary occupation of the zone is farming. Mixed crop-livestock production predominates, but there are some pastoralists in the lowlands. Generally, the climatic condition is conducive to livestock production.

2.2. Sampling Technique and Data Type

A multistage sampling procedure was used to select representative households from the study area. In the first stage, Sodo Zuria District was selected purposively as it is one of the potential milk production, processing, marketing and consumption areas of the country. Then nine kebeles were selected purposively on the basis of milk production and market participation potential. Among nine *kebeles,* four *kebeles* were finally selected randomly for the study. Sample frame of the kebeles was updated and sample size was determined using a simplified formula provided by Yamane (1967). A total of 120 farmers were randomly selected by using proportionate to size of dairy producers of respective *kebeles* (Table 1).

Table 2. Distribution of sample households across sample kebeles.

Sample kebele	Number of dairy farmers	Sample size
Kokate	625	44
DaliboAtaro	485	34
ZalaShasha	380	27
BosaKacha	220	15
Total	1710	120

Note: Sample proportion = 0.07.

Source: own survey result (2015).

In order to generate these data types. Both secondary and primary data sources were used in the study. The data collection methods used include discussions, observation, and formal survey. Survey instrument was–prepared and pre-tested with non-sampled households operating within the study area. Trained and experienced enumerators collected data from households during December to February 2015. For the milk traders' survey, the number of permanent traders in the main marketing channel in the study area was very limited, and all of the licensed and unlicensed traders 26 were interviewed.

2.3. Methods of Data Analysis

Both descriptive statistics and econometric models were used to analyze the data. Descriptive method of data analysis included the use of ratios, percentages, means and standard deviations in the process of identifying different channels in the study area. To identify factors affecting milk market outlet choices, multivariate probit model was used. The multivariate probit (MVP) model is a generalization of the probit model used to estimate several correlated binary outcomes jointly. For example, if it is believed that the decisions of selling agricultural output to channel 1 and channel 2 are correlated (both decisions are binary), then the bivariate version of the multivariate probit model would be appropriate for jointly predicting these two channel choices on an individual-specific basis.

The multivariate probit model approach in this study is characterized by a set of three (Hotels, traders and consumer channels) binary dependent variables y_{hpj} such that:

$$y^*_{hpj} = x'_{hpj}\beta_j + U_{hpj,} \qquad j = 1, 2, \ldots . m. \tag{1}$$

$$y_{hpj=}\begin{cases}1 \; if \; Y^*_{hpj}>0 \; (if \; the \; farmer \; choose) \\ 0 \; otherwise\end{cases} \tag{2}$$

where $j = 1,2, \ldots m$ denote the market outlets; $\boldsymbol{x'}_{hpj}$is a vector of explanatory variables, β_j denotes the vector of parameter to be estimated, and $\boldsymbol{u}_{hpj}$ are random error terms distributed as multivariate normal distribution with zero means and unitary variance.

It is assumed that a rational h^{th}farmer has a latent variable, y^*_{hpj} which captures the unobserved preferences or demand association with the j^{th} choice of market outlet. This latent variable is assumed to be a linear combination of observed households and other characteristics that affect the market outlet choice strategies, as well as unobserved characteristics captured by the stochastic error term.

Given the latent nature of the variabley^*_{hpj}, the estimation is based on the observed variable y_{hpj} which indicates whether or not a household choose a particular market outlet. Since choosing several market outlets is possible, the error terms in equation are assumed to jointly follow a multivariate normal distribution, with zero conditional mean and variance normalized to unity. The off-diagonal elements in the covariance matrix represent the unobservable correlation between the stochastic component of the j^{th} and m^{th} type of market outlet choice.

2.4. Definitions of Variables and Working Hypothesis

Channel Choice for Milk Marketing (CHACHO): The channel choice is farmers' decision involving different alternative channels; hotels, traders and individual consumers. It is measured by the probability of farmers' selling milk to either of marketing channels.

Independent variables

Sex of the Household Head (SEX): This is a dummy variable that takes a value of one if the household head is male and zero otherwise. Being female-headed household is expected to have a positive relation with milk market channel entry decision and milk sale volume. Generally, women contribute more labor input in feeding, cleaning of barns, milking, butter and cheese making and sale of milk and other dairy products (Somano, 2008). However, obstacles such as lack of capital, and access to institutional credit and extension service, may affect women's participation and efficiency in ruminant livestock production (Tanga *et al.,* 2000). Therefore in this specific study, the maintained hypothesis is that a female household head is expected to have either negative or positive influence on choice of market outlets and milk sale volume.

Family Size (FAMI): Size of household is a continuous variable and measured in adult equivalent. As dairying is labor intensive activity, dairy production in general and marketable surplus of dairy products in particular is a function of labor. Accordingly, households with more members tend to have more labor which in turn increases milk production thereby making them more willing to participate in marketing (Somano, 2008). However, household members are both production and consumption units, when there are fewer opportunities to contribute productivity; household units will be more consumption unit, as is the case in developing countries. That is, larger households

consume more and therefore less to sell (Makhura, 2001). The study hypothesized family size to have either positive or negative impact on volume of sales and channel choice.

Education Status of the Household Head (EDU): It is dummy variable takes a value of 1 if the household head is literate and 0 otherwise. Formal education is hypothesized to have positive influence on volume marketed and best channel choice. Astewel (2010) indicated positive relation between amounts of rice supplied to the market and level of education.**Livestock Ownership (TLU):** This is a continuous variable measured in tropical livestock unit and it excluded the number of cows. Farmers who have a number of livestock are anticipated to specialize in livestock production so that they allocate large share of their land for pasture. It is assumed that household with larger TLU have better economic strength and financial position to purchase sufficient amount of input (Kinde, 2007). Therefore, in this study TLU was expected to influences volume of milk sales and best channel choice positively.

Distance to Nearest Dairy Product Market (DIST): Distance to nearest dairy product market is the location of the dairy household from the nearest milk market and is measured in kilometers**.** The closer the dairy market to dairy household, the lesser would be the transportation charges, loss due to spoilage and better access to market information and facilities. This closeness can improve return to labor and capital; increase farm gate price and the incentives to participate in economic transactions. A study conducted by Holloway and Ehui (2002) revealed that distance to milk market was negatively related to the milk market participation decision of dairy households Therefore, in this study, distance to the nearest milk market was hypothesized to be negatively related to market participation decision and probability to choice best market channel.

Number of Dairy Extension Contact (EXTE): This is continuous variable representing dairy extension service as a source of information on technology and measured in number of contacts. Extension agents assist farmers in dissemination of new technologies, thus speeding up the adoption or use of new technologies and practices (Abraham, 2013). Producers who have had longer extension contact are expected to have more production and hence more market supply. The study expected to have positive effect for market supply and channel choice.

Number of Milking Cow (COW): This is a continuous variable measured in the number of milking cows owned by a household in TLU. As the number of dairy cows owned increases, milk production increases and percentage share of consumption declines and milk sales increase (Holloway and Ehui, 2002). Past studies indicated that the variable showed positive and significant relationship with market channel choice and marketable milk volume. Therefore, the variable is hypothesized to affect both market supply and channel choice positively.

Dairy Farming Experience (EXPE): This is a continuous variable measured in the number of years a household has been engaged in dairy farming. Households who have been in dairy farming for many years are expected to have rich experiences regarding opportunities and challenges of dairy production, processing and marketing. Staal *et al.* (2006) included the variable in probit model and found out that the variable revealed positive relation to milk market participation and market outlet choice. Also in this study it is hypothesized to affect milk market channel choice and supply positively.

Landholding Size (LAND): This is a continuous variable measured in hectare and it excludes grazing land. According to Staal *et al.* (2006) the variable has shown negative relationship with milk market participation and market outlet choice. In this study, it hypothesized to affect negatively on both dependent variables.

Presence of Children under Six Years of Age (CHILD): This is a dummy independent variable taking the value 1 if a household had at least a child less than six years of age and 0otherwise. There is a competition between milk for child requirement and the amount needed for market. Staal *et al.*, (2006) included the variable in probit model and found out that the variable revealed negative relation to supply and milk market outlet choices. The study also hypothesized negative relation with market supply.

Proximity to Urban Center (MI): It is a dummy variable taking 1 if the producer had near to urban center which is easy to access market information. Urban centers have available with different media like television, radio and Ethiopian commodity exchange market information screen; all are best source of national and international market information specially on price. It takes 1 and the value zero otherwise. Mamo and Deginet (2012) who found market information service increase the probability of selling directly to consumers in livestock market channel choice of farmers in Ethiopia. It was expected that market information will be positively affect channel choice and supply.

Total Income (INCM): This is continuous variable that refers to the total income from dairy and non-dairy activities. Abraham (2013) found that as the income from farm and nonfarm activity increases, the market supply. Hence it was expected that total income will be positively affect the market supply and channel choice.

Milk price by market outlet (PRICE): This is a continuous independent variable that is measured in Ethiopian birr. It is the actual price received by a household per liter of milk sold to milk market outlets. Staal *et al.* (2006) found out that the better the price offered by milk market channel, the more a household prefers that outlet for accessing and selling milk. They found out that price offered per liter of milk by individual consumer was lower than price offered by private trader and cooperative and thus households accessed these market outlets than accessing individual consumer milk market outlet. Therefore, the variable is hypothesized to affect positively milk supply and choice of best channel.

Size of milk output (YIELD): This is a continuous independent variable measured in liter. Past studies revealed that milk yield per day significantly and positively affected marketed surplus of milk (Singh and Rai, 1998; Woldemichael 2008). Therefore, the variable is hypothesized to affect accessing milk market outlet positively than others because of capacity to sell large volume of milk.

3. Results and Discussion

3.1. Milk Market Outlets

The major marketing outlets were identified and characterized by many intermediaries along the chain as reported in Table 2, below. The majority of farmers choose direct consumers as their major market outlet of milk, followed by hotels and small traders, respectively. Of the total volume of milk supplied by sample households, about 56.1%, 34.9% and 9% were sold to direct consumers, traders and hotels.

Table 2. Producers' market channel choices and volume of supply to each outlet.

Market channels	Producers' choice (Frequency, N)	Supply of milk in liters			
		Total	Mean	Percent	SD
Small Traders	42	11,931.03	67.95	9	67.95
Hotels	87	46,265.88	133.98	34.9	99.46
Direct consumer	90	74,370.09	198.84	56.1	163.79
Total	120	132,567	246.72	100	

Note: N- Number of observation, SD- Standard deviations

Source: Own survey result, 2015.

3.2. Determinants of Market Channel Choice

The model results in Table 3 show the choice set in the MVP model of three channel choices (traders, hotels and individual direct consumer). The correlation coefficient matrix rho21, rho31, rho32-represents the tetrachoric correlation between traders, hotels and direct consumer channels, respectively. The likelihood ratio test result indicated statically significant correlation among the channels, confirming that the multivariate probit specification and channel choices are interdependent household decisions.

The result of multivariate probit model indicated that the producers' likelihood to choose traders market channel was positively and significantly influenced by education status of households, distance to the nearest dairy market, total land holding, grazing land, and percentage of total milk produced. Hotels market channel choice was affected positively by number of milking cows, proxy to urban center, total land holding, family size and percentage of milk produced. Direct consumers market channel was also affected positively by grazing land.

Table 3. Multivariate probit simulation results of determinants of channel choices.

Explanatory variable	Small Traders		Hotels		Consumers	
	Coefficient	S.E	Coefficient	S.E	Coefficient	S.E
Children under age 6	-0.109	0.088	-0.074	0.11	0.035	0.074
Education status	0.141**	0.068	0.003	0.085	0.029	0.063
Grazing land	0.013	0.011	-0.016	0.016	0.011	0.011
Milking cow ownership	-0.079	0.166	0.885***	0.232	0.148	0.149
Access to market information	-0.615	0.454	0.899*	0.504	-0.674	0.461
Distance to market	0.156***	0.047	0.032	0.061	0.053	0.044
Total income	-0.04	0.379	0.812	0.577	0.066	0.362
Dairy farming experience	-0.009	0.018	-0.03	0.025	0.012	0.017
Livestock holding	-0.135	0.093	0.042	0.111	-0.112	0.095
Land holding	1.186***	0.435	0.587**	0.273	0.46	0.395
Extension contact	3.932**	1.695	1.262	1.909	2.596*	1.522
Family size	0.179**	0.074	0.271***	0.073	0.094	0.074
Milk price	-0.185	0.113	0.314	0.212	-0.138	0.107
Daily milk output per cow	1.064***	0.37	0.980*	0.582	0.302	0.349
Constant	-3.226	2.945	-15.217**	4.291	-1.804	2.793
Numbers observation				120		
Number of simulation (drown)				100		
Log pseudo likelihood				-144.78		
Wald chi2(42)				125.25		
Likelihood ratio test of rho21= rho31 = rho32= 0: chi2(3)				16.94***		

*Note: ***, **, and * are statically significant 1%, 5% and 10%, respectively and S.E, Standard Error.*

Source: Own survey result (2015).

Education status of household head: Education status of household head affected choice of small traders' market channel positively and statically at 5% significance level. This result indicates educated household heads more likely to choose the nearest market channel. This may be due to the fact that educated household heads are busy with meeting, trainings and other office related works.

Number of milking cows: Number of milking cows owned affected choice of hotels' market channel positively and significantly at 1% significance level. Hotels' market channel was found to be high volume buyer and the households who have more milking cows can produce and supply more output to the market.

Proximity to urban center affected choice of Hotels' market channel positively and significantly at 10% significance level. Households who are near to urban centers are also near to Hotels and they easily access the nearest market channel.

Distance to the nearest dairy market: It affected small traders' market channel choice positively and significantly at 1% significant level. This is due to the fact that small traders

are far apart from the nearest village market. When the distance to the nearest dairy market increases, the probability of households to supply to small traders market channel also increases.

Total land holding positively and significantly influences choice of small traders and Hotels market channel choice at 1% and 5% significant level respectively.

Extension service has positive and significant influence on the choice of small traders and direct consumers market channel at 5% and 10% significant level. Since it is input for dairy production, households who have more extension contact, produce more than those who have less contact. They produce more and supply to both the nearest and long distance market channels (small traders). It also influenced them to select relatively the best market channel (consumer).

Family size–significantly and positively influences small traders and Hotels market channel at 5% and 1% significant level respectively. As dairying is labor intensive activity, dairy production in general and marketable surplus of dairy products in particular is a function of labor. Accordingly, households with more members tend to have more labor which in turn increases milk production thereby making them more willing to participate in marketing (Somano, 2008). The fact in the study area was that households with more members tend to go far distance in searching for better price. Traders and hotels market channels are ~~is~~ relatively far from the producer households and they pay more when compared to individual consumers.

Milk yield affects the choice of small traders and hotels market channel positively and significantly at 1% and 10% significant level. When the daily milk yield per cow increases, households tend to sell to the distance market because of the perishable nature of the product.

Table 4 shows the predicted probabilities of the three channel choices, keeping all other explanatory variables at their mean values, indicated that the likelihood of choosing traders channel is 39.3% which is relatively lower than the probability of choosing direct consumer (52.8%) and hotels (52.4%). The likelihood of households' to choose the three channels jointly was 33.2% compared to joint probability of failure to choose all the channels simultaneously (10.1%). The joint probabilities of success or failure to choose the three channels suggest that households are more likely to choose multiple market outlets to sell their produce.

Table 4**.** Correlation coefficients and predicted probabilities of alternative channel choices.

Channels	Small traders	Hotels	Consumers
Small trader			
Hotels	0.385(0.306)		
Consumers	0.619(0.117)***	0.124(0.243)	
Predicted probabilities	0.393	0.524	0.528
Joint probability (success)	0.332		
Joint probability (failure)	0.101		

Source: Own survey result, 2015.

4. Conclusions

Based on the study, the major channels identified in the study area were small milk traders, hotels and individual consumers. Proximity to urban center, number of dairy extension contact, and dairy farming experience affected milk supply positively and significantly. On the other hand, family size has a negative and significant effect on the volume of milk supplied to market. Educational status of household head, number of milking cows, proximity to urban center, total land holding, grazing land, family size and sex of household head significantly and positively determined channel choices. Based on the result, separate estimation of choice of the market channel is biased and the decisions to choose the three channels are interdependent. Joint probabilities of success or failure to choose the three channels suggest that households are more likely to jointly choose the three channels.

Based on the findings of the study, the following recommendations are suggested to be considered by government and non-government organizations in their future intervention strategies aimed at providing supports for the development of milk production and marketing in the study area and other areas with similar setting.

- Distance to the market places has become important determinants in the marketing of milk. Hence developing market infrastructure in the form of establishing produce collection points across rural areas would assist poor farmers for faster delivery of farm produces especially perishable commodities like milk.
- The results of this study suggest several ways in which smallholder farmers can actively market their produce. The findings suggest that an adjustment in each one of the significant variables can significantly influence the probability of choice of market outlets.
- The study indicated that market information affect milk marketing positively and significantly. Milk marketing in the study area currently faces inadequate market information and limited information center. This indicates that there is a need to increase marketing efficiency through establishing skill transfer, building farmers' capacity to organize and access to up to date information. In turn, this will ensure success for the farmers in input-output marketing, value-addition and processing.
- Access to extension service was significant to milk market supply because it avails information regarding technology which improves production that affects the market supply. Moreover, establishing the dairy research–extension (transfer)–farmer linkages to develop and disseminate to farmers high yielding, disease resistant & environmentally adaptable breeds, market information and new technologies that can boost production and productivity of groundnut will help boost marketable surplus.

Further detailed research to analyze the determinants of milk marketed supply and economic impact of milk marketing channel choice on the welfare of dairy farmers in Sodo Zuria district should be done. This would give a broad picture of the economic, social, and institutional benefits derived by farmers while participating in different milk marketing channels.

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4. Determinants of Coffee Value Addition by Smallholder Farmers in Jimma Zone, Ethiopia

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Abstract

Value addition after production would involve enhancements or additions to a product that result in higher returns to the commodity seller. This study was undertaken with the aim of analyzing determinants of intensity of value addition to coffee by smallholders. Multi-stage stratified and simple random sampling techniques were employed and a total of 152 smallholder farmers from six kebeles were sampled. Data were collected from primary sources through a structured questionnaire. Tobit econometric model was employed to identify the underlying determinants of coffee value addition. The result revealed that sex, literacy status, coffee farming experience, active family labour force, perception of farmers towards the adequacy of extension service on value addition, access to credit, ownership of sufficient drying facilities, perception of farmers towards price of dry cherry, and non- and off-farm income significantly affected coffee value addition. The finding stress that policy aiming at offering farmers a fair price, providing adequate credit and other extension services, providing drying facilities, building capacity of farmers with knowledge, improving farmer's business diversification besides coffee farming, and targeting gender inclusive strategy (paying attention to women) were recommended to increase coffee value addition at farm level.

Keywords: Coffee; value addition; drying, hulling; Tobit model

1. Introduction

The emerging trend for processed agricultural products in the global market creates opportunities for smallholder farmers in the developing countries to benefit from such opportunities by linking their activities to value chains through vertical and horizontal linkages (Vermeulen *et al.*, 2008). While high-income countries add nearly US $185 of value by processing one ton of agricultural products, developing countries add approximately US $40. Furthermore, while 98 % of agricultural production in high-income countries undergo industrial processing, barely 38 % is processed in developing countries (Freeman, 2013). However, the prospects that lead firms such as brand owners, innovators and system integrators may appropriately increase shares of rent and therefore further widen the gap is very real (Altenburg, 2006).

Value addition can be broadly stated as the process of economically adding values to products (raw commodities) that possess intrinsic value in their original state by changing their current place, time, and form characteristics to improve their economic value and preferred by consumers in the market place (Fleming, 2005). According to these authors, value addition can be achieved in two ways, innovation and coordination. Value addition

through innovation focuses on improving the existing processes, procedures, products, and services or creating new ones, while value addition through coordination involves arranging partnership among the value chain actors that produce and market farm products, changing the distribution of value in the chain which in turn through direct marketing, vertical integration, producer alliances, and cooperative efforts. By producer alliances is to mean individuals/companies from the same level of the chain consolidate in order to produce and market a superior product whereas by cooperative effort is to mean individuals or companies pool their products in order to increase bargaining power.

Despite coffee's economic and social importance for the Ethiopian economy, the performance of smallholder farmers in the coffee sub-sector have remained unsatisfactory. Coffee farmers had very limited power when it comes to securing their adequate share of the market price from coffee (IFPRI, 2003). According to Desse (2008), coffee quality defects in Jimma is common mainly due to improper post-harvest processing and handling practices such as drying on bare ground, rainy weather particularly during drying season, and improper storage and transportation. In the study area, it is thus customary that coffee farmers have been promoted to harvest and deliver the red cherry to wet processing stations than being encouraged to farm-level value addition considering coffee defect is relatively high in dry cherry coffee. Furthermore, Abasanbi (2010) by his study recommended as wet processing is relatively a better approach to avoid common earthy and musty coffee defects. Because of this and other policy recommendations, farmers in the area have been encouraged to sell red cherry coffee without further farm level value addition improvements there by decreasing their competitiveness and bargaining power which in turn is leading to low earning than the income that would have been derived from dry cherry. However, farmers bargaining power while selling coffee in red cherry form is also very limited and gradually shifted to dry coffee than selling red cherry.

Value addition is very important for farmers as it can transform unprofitable agriculture into a profitable one (Fleming, 2005). Value addition after production would involve enhancements or additions to a product that result in higher returns to the commodity seller, who is often the farmer. From preliminary survey conducted prior in the study area, it is observed that selling value added coffee after drying would result in more earnings/profit than that of red cherry form. Yet, unlike their interest for value addition, farmers are challenged with many problems largely because of marketing environment, supportive services, resources, processing technologies, infrastructure, and economic and socio-demographic factors. There were farmers who did not add value on coffee while others add value. Besides, there was variation between the intensity of value addition between those farmers who were involved in adding value on coffee. Farm level coffee value additions vary across socioeconomic and demographic characteristics of farm households and also in relation to factors associated with market access and institutional support services. Thus, to put value addition as an alternative and formulating strategies in line with it, it was pertinent to first analyze the underlying determinants of intensity of coffee value addition by smallholder farmers

2. Methodology

2.1. Description of the Study Area

Jimma zone is located in the South-Western part of Ethiopia between Latitude 6^{o} and 9^{o} North and Longitude 34^{o} and 38^{o} East, and between altitude ranges of 880 to 3340 meters above sea level (ORG, 2003). It is one of the coffee growing zones in the Oromia Regional State, Ethiopia. Currently, the total area of land covered by coffee in the zone is about 0.1 million hectares, which includes small-scale farmers' holdings as well as state

and private owned plantations. Jimma zone covers a total of 21% of the export share of the country and 43% of the export share of the Oromia Region (JZARDO, 2008). In Jimma zone, coffee is produced in the eight districts namely, Gomma, Manna, Gera, Limmu Kossa, Limmu Seka, Seka Chokorsa, Kersa and Dedo, which serves as a major means of cash income for the livelihood of coffee farming families (JZARDO, 2008). For this study, Limmu-Kossa and Gomma districts were selected.

Limmu-Kossa district is geographically located between 70 50' to 80 36' North and 360 44' to 370 29' East (ORG, 2003). The total surface area of the district is 1355 km^2. Agro-climatic condition of the district comprises of highland (25%), midland (65%) and lowland (10%) with annual rainfall varying between 1200 to 2000 mm and altitude ranging between 1450 to 1950 masl while annual temperature is 10^{o}C to 25^{o}c. The total population of the district is 187,815 out of which 50.5% are male. There are about 29,138 households (92.3% male-headed) living in 40 *kebeles* and 3 towns (Limmu Genet, administrative center of district, Ambuye, and Babu). The average land holding size per household is 2.39 hectare out of which 24.6% is covered with annual crops.

Gomma is one of the known coffee growing districts of Jimma Zone. It is located 397 km Southwest of Addis Ababa and about 50 km west of Jimma town (ORG, 2003). Its area is 1,230.2 km^2. The annual rainfall varies between 800-2000 mm, while the mean minimum and maximum annual temperatures of the district vary between 7^{o}C-12^{o}C and 25^{o}C-30^{o}C, respectively (ARDO, 2008). Based on 15 years weather data obtained from Gomma district, the average annual rainfall is 1524 mm. Altitudinal range of the district is between 1387-2870 masl. The three dominant soil types in the district are Eutric Vertisols, Humic Alfisols and Humic Nitosols. Nitosols are the most abundant covering about 90% of the district, which is dark reddish brown in colour, slightly acidic and suitable for coffee production. Agro-ecologically, this district is divided into highland (8%), midland (88 %), and lowland (4%) (Figure 1).

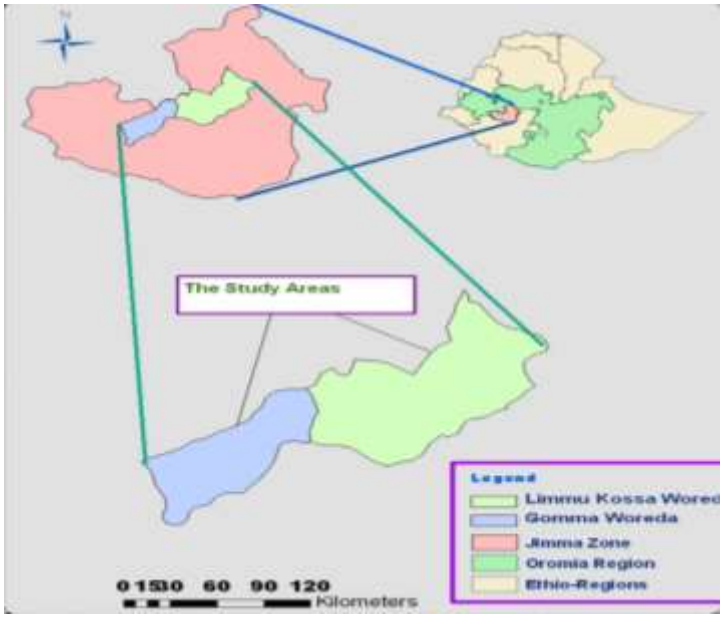

Figure 1. Map of the study area.

Source: Adopted and manipulated from Ethiopian map.

2.2. Sampling Techniques and Sample Size Determination

Stratification in the first and second, and simple random sampling technique in the third stage were employed to select samples. In the first stage, districts were stratified into two as potential and non-potential areas for coffee production. From among the eight potential districts, two districts namely Gomma and Limmu-Kossa districts were sampled randomly. Production potential of *kebeles* was again assumed to be important criteria to stratify *kebeles* for deriving representative sample *kebeles*. However, since it was difficult to get the estimated volume of coffee production in each *kebeles*, considering the agro-ecology was an alternative and best proxy for production potential in the study area. Thus, in the second stage, *kebeles* in the two districts were stratified into three by their agro-ecology as lowland, midland, and highland. The lowland agro-ecology covers less than 10% in both districts while the highland agro-ecology covers only 8% in Gomma district. Accordingly, *kebeles* were sampled randomly and proportionately from midland and highland category in Limmu-Kossa district and from midland category in Gomma district. After screening out non- producing *kebeles*, proportionately four *kebeles* from Limmu-Kossa district (three from midland and one from highland) and two midland *kebeles* from Gomma district were randomly selected to obtain six sample *kebeles*.

In the third stage, to consider the target populations (to avoid probability of including non-producers of coffee in the sample), only list of coffee farmers from sample *kebeles* were considered. Then, based on the number of coffee farmers available, proportional size of sample coffee farmers were selected from each sample *kebeles* using simple random sampling technique. Since adequate size of sample is needed for the purpose of econometric analysis (Israel, 1992), following the above sampling procedure, a total of 152 sample farmers were selected using Cochran (1963) sample size determination formula.

Both quantitative and qualitative data were collected for this study. Primary data were collected from smallholder farmers through a structure questionnaire with the help of trained enumerators.

2.3. Method of Data Analysis

Both descriptive and econometric analyses were used. Descriptive statistics was employed for testing the significances (by χ^2 or t tests) of farmers' characteristics across participation in value addition, and Tobit Econometric model was used to analyze the socio-economic factors affecting value addition.

Some households add value on some of their coffee, while others did not add at all. The data collected tend to be censored at the lower limit of zero. If probability of participation in value addition was to be analyzed, probit/logit models would be adequate techniques for addressing probability questions. However, the aim here was to look at the socioeconomic factors that affect intensity of coffee value addition. On the other side, ideally, multiple linear regressions (MLR) model would be applicable if all households participated in coffee value addition through drying but in this study some of the households did not participate in coffee value addition through drying. Some households preferred to participate in selling red cherry in favor of drying (adding value). Therefore, it was interesting to identify factors that influence the intensity of value addition leading to a need for an appropriate model which is the Tobit model that uses Maximum Likelihood estimation (MLE) (Tobin, 1958). A Tobit model answers both of the following questions: What factors influence the probability of value addition? What factors determine intensity of value addition? The results obtained from the Tobit procedure were the MLE or as well as the marginal effects. The marginal effects indicate the amount of coffee value addition in monetary value (birr) resulting from a unit change

in the explanatory variables. The change in probability, on the other hand, indicates the likelihood for the farmers to participate in value addition through dry processing approach. Using Tobit to determine factors affecting coffee value addition while controlling for other factors, the econometric model is expressed as:

$$y_i^* = \beta o + \sum_{i=1}^{m} \beta \mathbf{x}_i + \varepsilon_i$$

$$y_i = \begin{cases} y_i^* = \beta o + \sum_{i=1}^{m} \beta \mathbf{x}_i + \varepsilon_i, & if \quad y_i^* > 0 \\ 0 & if \quad y_i^* \leq 0 \end{cases}$$

Where Y_i is the monetary valuation of value added in thousands of birr, y_i* is the latent variable which is not observable; βo is an intercept; β_i is coefficient of the i^{th} independent variable; x_i is a vector of variables determining value addition of coffee; and $_i$ is 1, 2, 3... m; and ε_i is the error terms that are independently and normally distributed with mean zero and a common variance σ^2.

A change in explanatory variables has two effects. It affects the conditional mean of Yi* in the positive part of the distribution, and it affects the probability that the observation will fall in that part of the distribution.

1) The marginal effect of an explanatory variable on the expected value of the dependent variable is:

$$\frac{\partial E(Y_i)}{\partial X_i} = F(z)\beta_i$$

Where, z represents $\frac{\beta_i X_i}{\sigma}$ (Maddala, 1997).

2) The change in intensity of value addition with respect to a change in an explanatory variable among participants of value addition through drying coffee is:

$$\frac{\partial E(Y_i / Y^* > 0)}{\partial X_i} = \beta_i \left[1 - Z \frac{f(z)}{F(z)} - \left(\frac{f(z)}{F(z)} \right)^2 \right]$$

Where, F (z) is the cumulative normal distribution of z, *f* (z) is the value of the derivative of the normal curve at a given point (i.e., unit normal density), z is the Z-score for the area under normal curve, β_i is a vector of Tobit maximum likelihood estimates and σ is the standard error of the error term.

3) The change in the probability of participation in value addition as independent variable Xi changes is $\frac{\partial F(z)}{\partial X_i} = f(z)\frac{\beta_i}{\sigma}$

2.4. Definitions and Working Hypothesis

Dependent variable

Coffee value addition: It is a continuous variable represented by monetary valuation of total value added in thousands of birr by a farmer after drying red cherry coffee in 2013/2014 fiscal year.

Independent variables

Sex of the household head: It is a dummy variable taking 1 for male and 0 for female coffee farmers. Male headed households are assumed to participate in coffee value addition more than female headed one as more men are supposed to have better access to drying facilities, extension services, information and even credit than women. Mamo *et al.* (2014) indicated that male-headed households were related to volume of milk value added positively. Therefore, sex was hypothesized to affect intensity of value addition positively.

Literacy status of the household: It is a dummy variable considering the farmers' education status and taking 0 for illiterate and 1 for literate households. Households who are more educated are close to adopt processing and value adding technologies relative to those illiterate farmers there by affecting the probability to participate and level of value addition positively. Ngore *et al.* (2011) found that improving literacy levels among rural entrepreneurs would increase meat value addition in the rural agribusiness sector. Therefore, literacy status was expected to affect value addition positively.

Coffee farming experience: This is a continuous variable referring to the number of years since the start of coffee farming and assumed to affect intensity of coffee value addition positively. Farmers with longer production experience are expected to be more knowledgeable and skillful and then would most probably increase the amount of value added in coffee. Therefore, it is hypothesized to affect value addition positively.

Active family labour force: It is a continuous variable measured in adult equivalent (Strock *et al.*, 1991) that is the number of active labour force available in the household. Since production, processing (value adding activities) and other marketing activities are the function of labour, availability of labour was assumed to have positive relation with value addition. A study by Berhanu *et al.* (2011) revealed that availability of family labour force affected the level of milk value addition by the smallholder farmers positively at 1% significance level. Thus in this study, active family size was hypothesized to have positive impact on value addition.

Ownership of drying facilities: It is a dummy variable taking 1 if farmers replied that drying facilities are not a problem (have sufficient facilities) and 0 if they replied that it is a problem (do not have sufficient facilities). In the study area, the practice of farm level value addition activities greatly depend on the availability of drying facilities. Thus, the ownership of sufficient drying facilities create the opportunity to increase value addition in that it was expected to have positive influence on farm level coffee value addition.

Contractual agreement on red cherry: It is a dummy variable that takes 1 if the household head has contractual agreement with any buyer to supply red cherry coffee during the harvesting time of 2013/2014. The agreement is considered to bind farmers to dry little coffee or even not to dry at all. Farmers who get in to such a contract is expected to dry less amount of red cherry than those farmers who have no any

contractual agreement to provide coffee in red cherry form. Thus, it was hypothesized to affect amount of coffee value addition negatively.

Urgent need of the household: It is a dummy variable taking 1 if a household faced urgent need of money during coffee harvesting/picking time and 0 if not. In the study areas, there is a situation that red cherry coffee is the last option for earning money and farmers would be forced to sell red cherry coffee to meet urgent need of money. This in turn decreases the volume of coffee planned to be dried. Therefore, this variable was expected to affect the intensity of coffee value addition negatively.

Distance to urban center: It is a continuous variable measured in kilometers of distance from the farmers' residence to the nearest woreda towns. The advantage is that as farmers are close (near) to urban centers, they would have more interaction with informative peoples and get awareness about value addition, price information, its costs and benefits and overall market condition. The study of Berhanu *et al.* (2011) showed that participation decisions and intensity of farm level milk value addition were negatively related with distance from urban centers. Hence, it was expected to influence intensity of coffee value addition negatively.

Access to credit: This is a dummy variable taking a value 1 if the household takes loan for coffee value adding activities and/or marketing and other activities related to coffee and 0 if otherwise. Credit is a key financial instrument to break low level of value addition and marketing problem. It is critical in financing investment and purchase of new inputs (Ellis, 1992 cited in Shimelis, 2004). Ngore *et al.* (2011) found that enhancing access to credit would result in high meat value addition in the rural agribusiness sector. In Mamo *et al.* (2014), access to credit was also related with volume of milk value added positively. Hence, in this study access to credit was hypothesized to influence farmers' coffee value addition positively.

Perception of farmers towards extension service on value addition: It is defined as whether farmers have got an extension services related to farm level coffee processing (value addition). The variable was considered as dummy taking 1 if the farmers perceived that they got relevant/adequate extension service and 0 if otherwise. Ngore *et al.* (2011) found that extension service increase meat value addition in the rural agribusiness sector. So, the more the adequacy of extension service the more the farmer would be decisive on value addition affecting the amount of value added on coffee positively.

Perception of farmers towards current price of red cherry coffee: It is a dummy variable taking 1 if farmers assumed that it is attractive and relatively profitable and 0 if not. If the price of the red cherry is considered to be low (unattractive), it would not encourage selling red cherry rather encouraging farmers to dry and add value on coffee. Therefore, it was hypothesized that price of red cherry affects coffee value addition negatively.

Perception of farmers towards current price of dry cherry coffee: It is a dummy variable taking 1 if farmers assumed that price of dry cherry is relatively profitable and 0 if not. If the price of the dry cherry is considered to be low (unattractive) for farmers, farmers would hoard it (if already dried) or even would not be encouraged to add value on coffee (dry) rather would sell in red cherry form compared to the case when price of dry cherry is attractive. Hence, perception of farmers about the price of dry cherry coffee was hypothesized to have a direct relationship with intensity of value addition.

Consideration of coffee drying for saving and/or bargaining mechanism: This is a dummy variable taking 1 if farmers believe or consider that drying coffee is a saving/bargaining mechanism and 0 if not. The need to coffee value addition or to use dry cherry coffee as a saving mechanism is another very important factor there in the study areas in that drying a red cherry coffee and storing in dry cherry form is a saving mechanism and a way of increasing bargaining power of the smallholder farmers. Thus, this variable was expected to affect intensity of coffee value addition positively.

Membership to coffee cooperative: It is a dummy variable taking the value of 1 if the household is a member in coffee cooperatives and 0 if otherwise. Cooperatives can develop members' understanding about market and strengthen the relationship among the members. Moreover, membered households can get an opportunity to receive training on value addition, exchange ideas and learn better about the benefits of value addition and are thus willing to take the extra steps of adding value on coffee. Berem *et al.* (2010) found that the decision to add value on honey is positively and significantly influenced by group membership. On the other hand, there is also an experience in the study area that cooperatives are advocating their members to supply red cherry than that of dry cherry because of the fear (doubt) that coffee quality would be deteriorated relatively when dried at the farm level. Therefore, this variable was expected to be associated with coffee value addition either positively or negatively.

Non- and/ or off-farm income: It is a continuous variable which refers to part of the total amount of income measured in birr (and transformed to log) that is received from business activities (fire wood gathering, charcoal trading, agricultural trading, local drink selling, service provision, pension, aid from relative etc.) other than farm activities by the household. If earning from non/off-farm income is higher than income from coffee, farmers would mostly shift towards the non/off-farm income activities due to the fact that farmers with better non/off-farm income would not tend to generate cash from sell of agricultural commodities rather is from their non/off-farm activity. Similarly if households earn more non/off-farm income, they could wait for higher price of coffee (by drying and storing for the future) than selling immediately. In these ways, it has positive effect on value addition. Again this variable increases the financial strength of the farmers to invest more on the purchase of facilities and incur labour cost for value adding activities. In this way, this variable is assumed to affect value addition positively. In Mamo *et al.* (2014), income from non-dairy source was related with volume of milk value added positively. Berem *et al.* (2010) also found that amount of hours spent on off-farm activities increased the honey value addition. Thus, it was hypothesized to affect intensity of coffee value addition positively.

3. Results and Discussion

3.1. Farmers' Characteristics by Participation in Value Addition

Drying and hulling (dry processing) were practices through which farmers add value on the commodity itself besides other handling practices. An average of 10.1 and maximum of 65.28 quintals of value added coffee was obtained through farm level value addition by smallholder farmers. About 87% of total respondents had engaged in coffee value addition through dry processing (either by drying and/or further hulling processes). The remaining 13% did not practice value addition by dry processing. However, 90.78% of all farmers are not engaged in hulling dry cherry coffee in to sundried coffee. Only 9.2% of farmers are engaged in hulling process. From among 132 farmers who engaged in value addition, only 14 (10.61%) practiced further value additions through hulling process, whereas the rest 118 (89.39%) of the 132 practiced only drying red cherry coffee.

It implied that the majority of the farmers were limited to undertake further hulling process beyond drying. On the other way, from those who did not hull (138), 19 (13.77%) were those who did not already dry the red cherry coffee and the remaining 119 (86.23%) were from those who dry coffee. However, it is obvious that all (100%) of those who hull coffee are from those who already practiced drying red cherry coffee. It is because hulling is not expected unless red cherry coffee is dried first.

Table 1 presents mean/proportion comparison of demographic and socio-economic characteristics of sample farmers across participation in value addition (by dry processing). The study indicated that demographic characteristics like sex, literacy status, and age of sample farmers have significant difference among the participation in value addition at 1%, 1% and 10% significance level respectively. It was revealed that 90.91% and 86.36% of those farmers who participate in value addition were those who are male headed and literate households respectively. With regard to price and value addition, 89.39% of those farmers who engaged in value addition were those who perceive price of dry cherry is attractive. 90% of those who did not engage in value addition were those who perceive price of dry cherry is low. On the other hand, 60.61% of those who did participate in value addition were those who perceive price of red cherry is unattractive. The result of chi square tests also revealed that the two price components, price of dry cherry and price of red cherry have significance difference among participation in value addition at 1% and 5% significance level, respectively.

As seen in below Table 1, 63.64% and 69.7% of those farmers who participated in value addition are those who were members of primary cooperatives and those who received credit. The result of chi square test indicated that membership in cooperative and access to credit showed significance difference among those who add value and those who did not add value on coffee through dry processing at 5% and 1% significance level. Other variables like adequacy of extension service on value addition, contractual agreement, consideration of dry cherry for saving/bargaining mechanism, farming experience, non/off-farm income and volume of coffee harvested revealed significant difference among participation in value addition at 1% significance level (except at 10% for adequacy of extension service on value addition and at 5% for non/off-farm).

Table 3. Mean/proportion comparison of variables by participation in coffee value addition.

Variables	Participation in value addition			Pearson
	No (N= 20)	Yes N=1322)	Total (N=152)	χ^2/ t
District (Gomma, %)	80	44.7	49.34	8.66***
Sex (male, %)	55	90.91	86.18	18.81***
Literacy status (literate)	55	86.36	82.24	11.7***
Cooperative (yes, %)	40	63.64	60.53	4.06**
Credit (yes, %)	20	69.7	63.16	18.44***
Extension on value addition (yes, %)	30	15.15	17.11	2.7*
Price of dry cherry coffee (attractive, %)	10	89.39	78.95	65.87***
Price of red cherry coffee (attractive, %)	15	39.39	36.18	4.48**
Ownership of drying facility (yes, %)	70	63.64	64.47	0.31
Contractual agreement on red cherry (yes, %)	85	24.24	32.24	29.35***
Dry cherry for saving/bargaining (yes, %)	0	32.58	28.29	9.09***
Age (year)	39.9	44.23	43.66	-1.85*
Farming experience (year)	10.65	17.52	16.62	-3.3***
Active family labour force (number)	2.2	3.17	3.05	-2.34**
Non/off-farm income (birr)	305	6566.52	5742.63	-2.19**
Volume of coffee harvested (qtl)	8.15	48.07	42.82	-4.17***

*Note: ***, **, and * significant at 1%, 5% and 10% significance level, respectively, N=sample size.*

3.2. Econometric Results on Determinants of Value Addition

Tobit's maximum likelihood estimates, marginal effects and change in probability of participation in value addition are presented below (Table 2). The likelihood function of the model is significant (LR chi2 (15) = 261.27, Prob > chi2= 0.0000) indicating the model is adequate because coefficients are jointly significant. Sex, literacy status, coffee farming experience, active family labour force, extension service on value addition, credit access, perception of farmers towards current price of dry cherry coffee, ownership of drying facilities, and non- and/or off-farm income significantly affected intensity of coffee value addition (Table 2).

Table 4. Maximum likelihood estimates of Tobit model of coffee value addition.

Variable	Coefficient	Standard Error	Marginal effect[1]	Marginal effect[2]	Change in probability
Sex	4.98***	1.55	4.80***	4.21***	0.0952**
Literacy status	2.18**	1.07	2.10**	1.84**	0.0417*
Coffee farming experience	0.17***	0.04	0 .16***	0.14***	0.0032***
Active family labour force	1.31***	0.29	1.26***	1.11***	0.0250***
Extension service on value addition	7.90***	1.28	7.62***	6.68***	0.1510***
Distance to urban center	0.01	0.10	0 .01	0.01	0.0002
Access to credit	1.78**	0.84	1.72**	1.51**	0.0341*
Ownership of drying facility	2.36***	0.84	2.28***	2.0***	0.0451**
Price of red cherry	0.21	0.94	0 .20	0.18	0.0040
Price of dry cherry	2.92***	1.06	2.81***	2.47***	0.0558**
Membership in coffee cooperative	0.83	0.76	0 .80	0.70	0.0158
Non- and/or off-farm income (log)	5.93***	0.35	5.72 ***	5.02***	0.0492***
Consideration of drying as saving and/or bargaining mechanism	1.41	1.13	1.36	1.19	0.0269
Contractual agreement on red cherry coffee	-0.95	0.95	-0.92	-0.81	-0.0182
Urgent need to sell red cherry	-0.07	0.85	-0.07	-0.06	-0.0014
Constant	-31.14***	3.07			
Sigma	4.14	0.25			
Pseudo R^2 = 25.5%		Number of observations = 152			
Log-likelihood = -382.54		Left-censored observations = 20			
LR chi2(15) = 261.27***		Uncensored observations = 132			
Prob > chi2= 0.0000		Right-censored observations = 0			

Note: - Dependent variable is represented by monetary valuation of value added on coffee (thousands of birr).

****significance at 1% level, ** significance at 5% level, and *significance at 10% level.*

Sex of the household: As expected, sex affected coffee value addition negatively at 1% significance level. The marginal coefficient values for this explanatory variable were found to be 4.8 and 4.21 implying that being male-headed household against that of female-headed would increase the intensity of value addition by 4800 birr among the whole sample and by 4210 birr among the participant group. The result supports the study of Mamo *et al.* (2014) in that being male headed household was related with volume of milk value added positively. This variable would also increase the probability of value

[1] The effects of change in the explanatory variables on the expected value of the dependent variable among the whole sample

[2] The change in intensity of value addition with respect to a change in an explanatory variable among participants

addition significantly by 9.52%. These implied that conditions of coffee value addition activities are favorable for male headed than female headed farmers.

Literacy status: It was positively related with value addition at 5% significance level. The computation of marginal effects showed that while all other variables in the model held constant, being literate would increase coffee value addition by 2100 birr among the whole sample and by 1840 birr among the participant group. Being literate household also led to an increase in the probability of coffee value addition by 4.17%. Households who have better education are likely to understand importance of value addition through drying coffee. It is probably due to the reason that more educated farmers are close to adopt processing and value adding technologies relative to those illiterate farmers there by increasing the intensity of value addition positively. This result agrees with the findings of Ngore *et al.* (2011) who found that improving literacy levels among rural entrepreneurs would increase the level of meat value addition in the rural agribusiness sector.

Coffee farming experience: This variable affected the intensity of value addition significantly and positively at 1% level. It implied as farmers stay longer in coffee farming business, it is expected to increase value addition through drying and/or further processing. All other factors being unchanged, a one year increase in farming experience leads to an increase in coffee value addition by 160 birr among the whole sample and by 140 birr among the participant group. As experience increased by a year, the likelihood of value addition would also increase significantly by 0.32%. This is probably due to the reason that as farmers are experienced with coffee farming, they would be aware of the benefits of drying coffee and engages in value addition than those famers with few years of farming experience.

Active family labour force: In line with the expectation, labour force affected coffee value addition positively at 1% significance level. Other factors being constant, a one person labour force availed in the family increased the coffee value addition by 1260 birr among the whole sample and by 1110 birr among the participant group. As the number of laborer in the family increased by one, the probability to participate in value addition would increase by 2.5%. This result was in confirmation with Berhanu *et al.* (2011) who revealed that availability of family labour force affected level of milk value addition by the smallholder farmers positively.

Extension service on value addition: As expected, this variable was found to be positively associated with coffee value addition at 1% significance level. The marginal effects of this variable showed that as farmers are addressed with extension service, value addition increased by 7620 birr among the whole sample and by 6680 birr among the participant group. Extension service on value addition increases the probability of adding values on coffee by 15.1%. This result was in line with the study of Berhanu *et al.* (2011) who revealed that negative livestock extension services decreased milk value addition.

Access to credit: This variable affected the intensity of coffee value addition positively at 5% significance level. The marginal effects for this variable revealed that those who have got credit access would increase value addition by 1720 birr among the whole sample and by 1510 birr among the participant group. Credit access increases the likelihood to participate in value addition by 3.41%. These explain that credit is a key financial instrument to break the low level of value addition and marketing problem. This result supports the study of Ngore *et al.* (2011) who revealed that enhancing access to credit

would result in high meat value addition in the rural agribusiness sector. In Mamo *et al.* (2014), access to credit was related with volume of milk value added positively.

Ownership of sufficient drying facilities: As hypothesized, intensity of coffee value addition was related with the availability of drying facilities for farmers positively at 5% significance level. The marginal effects for this explanatory variable were found to be 2.28 and 2 implying that for those who assumed that they had enough drying facilities, the value added on coffee would increase by 2280 birr among the whole sample and by 2000 birr among the participant group. Having enough coffee drying facilities increased the likelihood of value addition by 4.51%. The result indicated that practice of farm level coffee value addition activities were greatly depending on the availability of drying facilities.

Perception of farmers towards current price of dry cherry: This variable also affected coffee value addition positively at 1% significance level. As farmers perceived that price for dry cherry is attractive, value addition would increase by 2810 birr among the whole sample and by 2470 birr among the participant group. Consideration of price of dry cherry as attractive would increase the probability of participation in value addition by 5.58%. The results, therefore, suggested that farmers to be encouraged in coffee value addition through drying, increasing price of dry cherry would be a strategy. Thus, keeping other factors constant, the more attractive the price of dry cherry, the better would be the participation in and intensity of value addition.

Log of non- and/or off-farm income: It affected intensity of coffee value addition positively at 1% significance level. The marginal effects revealed that, on average, a one percent increase in non- and/or off-farm income would result in an increase in value addition by 57.2 birr among the whole sample and by 50.2 birr among the participant group. This may be explained by the fact that farmers with a better non-and/or off-farm income would diversify their coffee business like value addition since the financial strength of farmers to invest more on the purchase of facilities and disbursing on labour cost for value adding purpose and/or to wait for future higher prices from coffee would increase. This finding coincided with the results of Mamo *et al.* (2014) who revealed non-dairy income source affected milk value added positively and Berem *et al.* (2010) that amount of hours spent on off-farm activities increased the honey value addition.

4. Conclusion and Recommendations

The result indicate that female headed households were not in a better position in adding value to coffee compared to the male headed households indicating that giving due attention to female headed by improving access to credit and other extension facilities is mandatory. Women should be targeted while providing training and other extension service for farmers. Literacy status is another significant variable that affect intensity of value addition positively. Building education capacity of rural farmers through arranging consecutive trainings and experience sharing sessions among smallholder farmers or arranging other formal way of education should be designed to increase farm level coffee value addition. The adequacy of extension service provided and ownership of drying facilities to farmers have also something to do with enhancing value addition. It is, therefore, important to serve farmers with appropriate extension service provisions and offering drying facilities for farmers so that they would be encouraged to add value. Assigning professional development agents and upgrading their knowledge and skills to provide adequate extension services is recommended. The study also indicated that access to credit enables farmers to increase value addition. Thus, strengthening the

financial capability of farmers by providing adequate credit is the necessary strategy to increase intensity of value addition. It is necessary to finance cooperatives/unions sufficiently to solve severe financial problems of farmers. Modern value chain financial products (more importantly warehouse receipt finance) as an alternative for credit provision should be established.

Non-and/or off-farm income is another important factor that affected value addition positively. Hence, encouraging farmers to diversify their business besides coffee is an alternative way to enhance coffee value addition at the farmer level. On top of these, price of dry cherry coffee affects value addition positively. Therefore, there should be a system that prevent suppliers not to fix prices below some threshold limit.

In general policy aiming at offering farmers a fair price, providing adequate credit and other extension services, improving marketing infrastructures, building capacity of farmers, encouraging farmer's business diversification besides coffee farming, targeting gender inclusive strategy (paying attention to female headed households) are recommended to increase coffee value addition at farm level.

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5. Supply and Performance of Wheat Markets in Digelu-Tijo District of Oromia Region, Ethiopia

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Abstract

Analyzing the supply and performance of wheat markets for smallholder farmers is important to improve their marketed surplus and initiate them for commercialization. The objectives of this paper are to analyze the marketed surplus of wheat by smallholder farmers and to identify its underlying determinants. Two- stage sampling technique was used and a total of 123 smallholder farmers from five kebeles were randomly selected for the survey using probability proportion to number of households. The dataset was generated through household level survey employing pre-tested interview schedule. The data was analyzed using descriptive statistics and Tobit model. The model results showed that six explanatory variables significantly affected the volume of wheat marketed by smallholder wheat producers. Family size, access to credit, off- farm income and livestock holding had negative and significant effect on wheat supply. Oxen ownership and perception of farmers towards wheat market price, on the other hand, had positive and significant influence on market supply of wheat. Based on the findings, some of the policy recommendation are promoting family planning, awareness to farmers to supply wheat to the market when price is fair for them, and encouraging farmers on rearing livestock besides crop production and involvement in both off-farm and farming activities to improve their livelihoods.

Keywords: Digelu-Tijo; market performance; market supply; smallholders; Tobit; wheat

1. Introduction

Ethiopia has adopted commercialization of smallholder agriculture as a strategy for its economic transformation. The agricultural services of extension, credit, and input supply are expanding significantly to support commercial transformation, although the dominant player in these services remains to be the public sector. The expansion of agricultural services had significant impact on the intensity of input use, agricultural productivity, and market participation of Ethiopian smallholders (Leykun and Jema, 2014). The production of wheat and other crops in the country is insufficient to meet the increasing demand for food. Ethiopia's self-sufficiency in wheat production is only 75 percent and the remaining 25 percent is imported commercially and through food aid (GAIN, 2014).

The study area, Digelu-Tijo district, is the major cereal producing area where wheat is the dominant crop produced by majority of households. This district is endowed with natural resources suitable for growing different annual crops. Even though the district is favorable for cereal production, there are several socio-economic factors constraining the market supply of wheat and performance of wheat markets.

2. Research Methodology

2.1. Description of the Study Area

Digelu-Tijo district where the study was conducted is located 198 km southeastern of Addis Ababa and 23 km southeastern of the capital city of Arsi zone, Assella. The main asphalt road running from Addis Ababa to Bale Robe also crosses the district. The district is geographically located 07°45' N latitude and 39°09' E longitude. It is found west of Munesa, north of Tiyo, south of Lemu-Bilbilo, east of Tana, northeast of Hetose and southeast of Shirka districts of Arsi zone. The major district town in Digelu -Tijo is Sagure. There are 23 rural and 5 urban kebeles in the district (Digelu-Tijo Woreda Office of Agriculture, 2015).

The district total population and households are estimated to be 140,413 and 18,712 respectively. Out of these, 49.5% are men and the remaining women (CSA, 2007). The district consists of two major climatic zones based on altitudes, rainfall and temperature: 78% highlands and 22% midlands. The attitude ranges from 2000 to 3600 meters above sea level. Its minimum annual temperature ranges between 15° c and 22° c. The mean annual rainfall of the district ranges from about 1000 mms to 1500 mms. The district has a unimodal rainfall and the main rainy season is from June to September. It is considered as one of the surplus producing districts, especially for wheat. The commonly produced types of local wheat varieties in the district are *danda'a*, *digelu*", *madda walabu*, *sofumer* and *kubsa*. (Digelu-Tijo Woreda Office of Agriculture, 2015).

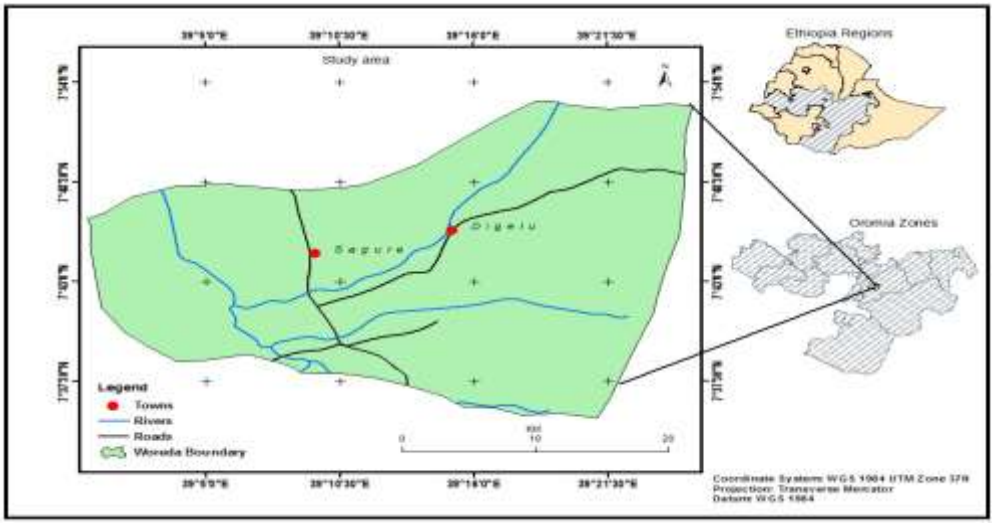

Figure 1. Location map of the study area.

Source: Adopted and manipulated from Ethiopian map.

2.2. Sampling Technique and Sample Size Determination

Digelu-Tijo district was selected purposively for the district is a predominant grower of cereal crops in Oromia region of Ethiopia where the environment is particularly suitable to produce wheat crops.

A two stage sampling technique was used to select sample respondents for the interview. In the first stage, five kebeles in the district were selected randomly. In the second stage, proportional sampling method was employed to draw representative samples from the sample kebeles (Table 1). A simplified formula suggested by Yamane (1967) was used to determine sample size at 0.09 level of precision.

$$n = \frac{N}{1 + N\,(e)^2}, \qquad \frac{18712}{1 + 18712(0.09)^2} = 123$$

Where, n= the sample size, N= the number of households in the district.

e = is the level of precision (=0.09)

Table 5. Distribution of sample households across kebeles.

Sample kebeles	Number of wheat producers	Sample proportional (%)
Fite katar	744	27
Lole katar	709	25
Qacema Murqica	695	25
Sagure Mole	659	23
Mankula Nagele	652	23
Total	3459	123

Source: Digelu-Tijo District Office of Agriculture.

2.3. Method of Data Collection and Analysis

The situation of the marketing system from the producer up to the end consumer was assessed through rapid market appraisal. Semi-structured and pre-tested interview schedule was used to collect primary data from households that were randomly selected from five kebeles. Also, interview was conducted with experts at district agricultural office, district trade and market development office and different market actors. Secondary data was obtained from the district agriculture offices, Central Statistics Agency reports, published and unpublished materials.

Two types of analysis, namely descriptive analysis and econometric methods were employed to meet the objectives of the study. The market supply data was censored, which means that there were households who produced wheat but did not supply to the market. Tobit model was selected to identify factors determining the supply of wheat by smallholder farmers. Tobit model answers both factors influencing the probability of selling and factors determining the magnitude of sale.

Statistically, we can express the Tobit model as

$$y_i = \mathbf{x}\boldsymbol{\beta} + \varepsilon_i$$

$$y_i = \begin{cases} \mathbf{x}\boldsymbol{\beta} + \varepsilon_{i_i}, \ if \ \ y_i^* > 0 \\ 0 \qquad\qquad if \ \ y_i^* < 0 \end{cases}$$

where y_i is volume of wheat marketed, and the $\mathbf{x}$'s are vectors of covariates determining the intensity of wheat sales.

2.4. Definition of Variables and Working Hypotheses

Dependent variable

Volume of Wheat Marketed (VWM): It is a continuous dependent variable and measured in quintals (log-normalized). It represents the log of the actual volume of wheat marketed by farm households.

Independent (explanatory) variables

Perception of farmers about price of wheat (price): If a farmer perceived prevailing price of wheat as attractive, there would be an increase in volume of marketed surplus, Adesiyan *et al.,* (2012) found that an average price of paddy received by farmers affected marketed surplus of the crop positively. A study by Wolelaw (2005) found a significant positive relationship between rice sold and market price.

Distance to the nearest market (DNM): Distance to the nearest market is a continuous variable measured in kilometers. Distance to the nearest market is expected to have inverse relationship with volume of wheat marketed (Muhammed, 2011).

Sex of the households (SHH): Sex is a dummy variable which takes a value of one if the household head is male and zero if female. Being male headed household is expected to have positive relationship with marketed surplus. Mamo and Degnet (2012) found that sex of household head had statistically significant effect on participation of producers in the livestock market.

Family size (FS): It is a continuous variable measured in terms of adult equivalent. Families with more household members tend to have more active labour for production and marketing. However, large family size requires large amount of consumption that reduce marketed surplus. Therefore, family size can affect the volume of wheat marketed either positively or negatively.

Access to credit (ACD): Access to credit is measured as a dummy variable taking value of one if the farmer had access to credit and zero otherwise. According to Kebede (1995), credit makes traditional agriculture more productive through purchase of farm equipment and other agriculture inputs. However, Amare (2015) found that access to credit affected the marketed surplus of pepper negatively.

Level of education (LED): It is a continuous variable that is expected to affect the volume of wheat marketed positively. This is because a farmer with good knowledge can adopt better practices that would help to increase the volume of wheat marketed. Holloway *et al.*, (1999) argued that education had positive significant effect on quantity of milk marketed in Ethiopia highlands.

Frequency of extension contact (FEXC): Refers to the number of contacts per year that the household head made with development agents during production season. Extension visits help to reinforce the message and enhance the accuracy of implementation of technology packages Babatunde *et al.,* (2007), thus to have a positive effect on the volume wheat marketed.

Land allocated to wheat (LAW): This variable is a continuous variable measured in hectares that households allocated for wheat production during 2015/16 production season. Farmers with larger area of cultivated land have the capacity to use technologies

that could increase the production and productivity. According to Bedada *et al.* (2015) large farms were providing large volume than small size farms. Hence, it was hypothesized that cultivated land size would have a positive effect on volume of wheat marketed.

Number of Oxen Owned (NOO): The number of oxen owned by the household is expected to affect volume of wheat marketed positively. According to Tesfaw (2013), the larger the numbers of oxen owned by a farmer, the greater households supply of their produce to the market.

Livestock holding (LH): It is a continuous variable measured in tropical livestock unit (TLU). Farmers who have low production need to specialize in livestock production. Therefore, it is expected to have negative relationship with volume of wheat marketed. Rehima (2006) found a significant negative relationship between total livestock owned and quantity of pepper supplied to market.

Off-farm income (OFI): It is a continuous variable measured in Birr that a farmer earned (log-normalized) from activities other than farming. Rehima (2006) found that the amount of pepper supplied to the market decreased with increased off-farm income. Therefore, it was hypothesized that farmers who engaged in off-farm income would supply less volume of wheat to market.

Farming experience (FE): It is a continuous variable measured in years. Experience would improve the farmer's skill on the use of modern agricultural inputs like selected seed, fertilizer, chemicals that help enhance productivity and increase marketable surplus. A study conducted by Ayelech (2011) indicated that farmers with longer farming experience were more knowledgeable and skillful and are more successful in their production. Thus, farming experience is expected to have positive relation with volume of wheat marketed in the study areas.

Quantity of fertilizer used (QFU): It is a continuous variable measured in quintals. Geda *et al* (2004) studied fertilizer use as one factor affecting agriculture. A study conducted by Alene *et al* (2008) indicated that fertilizer use had positive effect on market participation in Kenya. Thus, quantity of fertilizer used was expected to have positive relation with volume of wheat marketed in the study areas.

Use of improved wheat variety (UIWF): It was dummy variable taking value of one if the farmer used improved wheat variety, and zero if improved seed not used. A study conducted by Weisz and Cowger (2014) in North Carolina found that use of improved wheat variety had positive impact on yield. Thus, use of improved wheat variety was expected to increase marketable surplus and thereby increase the volume of wheat marketed in the study areas.

3. Results and Discussion

3.1. Characteristics of Sample Households

The t-test (Table 2) shows that there was statistically significant (1%) difference between market participants and non-participants households with regards to market supply of wheat. An average volume of wheat sold by market participants was 19.95 quintals per household. Of the 123 sample respondents, 84 percent reported that they had supplied wheat to the market, whereas the remaining 16 percent of respondents did not supply

wheat to the market in the survey year. The average number of family members was about 5.4 persons for participant farmers and 6.7 for the non-participants.

Average age of the wheat market participants was greater (by 6.39 years) than non-participants and the difference is statistically significant at 5%. There is a statistically significant difference in mean years of farming between the two groups. Production cost was greater for households who participated in wheat market than non-participants and the difference is statistically significant at 1%. The average land covered by wheat was 2.73 and 1.65 hectares for participant and non-participant households, which is statistically significant at 1%.

The average wheat yield in the study area was 31.62 quintals in 2015/16 production season. This yield level is larger than both the national average yield (25.43 q/ha) and the regional average yield (28.21q/ha). This shows potential of the district for wheat production at national level.

Table 2. Characteristics of sample households by wheat market participation.

Variables	Mean/Proportion			
	Participant s	Non-participants	Both	t-/z-/χ^2 statistic
Wheat supply by the household	19.95	0	16.70	3.71***
Family size of household	5.36	6.74	6.05	-1.99**
Literacy status of household head	1.29	1.25	1.27	0.17
Age of household head	46.74	40.35	43.55	2.14**
Wheat farming experience	23.99	16.8	20.39	2.53***
Access to credit (%)	0.55	0.85	0.70	-2.48***
Distance to the nearest market	3.17	2.90	3.04	0.51
Quantity of fertilizer used	2.42	1.43	1.93	3.31***
Land covered by wheat	2.73	1.65	2.19	3.53***
Frequency of extension contact	1.43	1.45	1.43	-0.18
Income from wheat(log)	9.49	0	9.31	5.27***
Off-farm income (log)	7.60	8.29	7.92	-1.66**
Wheat price (log)	6.68	0	6.68	2.22**
Production cost	9.29	9.02	9.25	3.58***

*Note: *** and ** statistically significant at less than 1% and 5% significance level.*

Source: Survey result, 2016.

3.2. Econometric Results

Fourteen hypothesized explanatory variables (11 continuous and 3 dummy) were included in the Tobit model to identify factors affecting the volume of wheat marketed. Out of these variables, six were found to have significant influence on volume of wheat marketed at 1 and 5 percent levels of significance (Table 3). These variables include perception of farmers about wheat market price, family size, access to credit, livestock holding (TLU), off-farm income, and oxen ownership.

Table 3. Tobit model outputs of determinants of wheat market supply.

Variables	Coefficient Coefficients	Standard error	Marginal effects Intensity of sales	Probability of sales
Distance to the nearest market	0.02	0.04	0.02	0.0008
Sex of household head	0.16	0.37	0.15	0.01
Family size	-0.08	0.03	-0.07**	-0.003
Access to credit	-0.91	0.19	-0.84***	-0.04
Level of education	0.02	0.09	0.02	0.001
Frequency of extension contact	0.21	0.18	0.19	0.02
Land allocated to wheat	-0.15	0.35	-0.14	-0.01
Off- farm income	-0.07	0.03	-0.06**	-0.003
Livestock holding in TLU	-0.09	0.02	-0.08***	-0.04
Farming experience	-0.002	0.008	-0.008	-0.00007
Oxen ownership	0.34	0.11	0.31***	0.01
Perception of wheat market price	7.96	3.83	7.26**	0.34
Quantity of fertilizer used	0.46	0.35	0.42	0.02
Use of improved wheat variety	-1.07	1.01	-1.04	-0.01
Constant	-49.99	25.76		
LR $chi^2(14)$		104.49		
Pseudo R^2		0.2484		
Left-censored observations		20		
Uncensored observations		103		

*Source: Model output, ***, ** represents 1% and 5% level of significance respectively.*

Family size: As the marginal effects of intensity shows, a unit increase in family size of a household decreases volume of wheat marketed by 7%. This means that large amount of wheat is required for consumption rather than for sale when number of family member in the household increases. The marginal effect indicates how likely family size has chance to sell wheat. The result indicates that one number increment of family size in the households decrease probability of selling wheat by 0.3% .This is in line with a study by Astewel (2010) who found that increase in family size decreased the supply of rice to the market. Similarly, a study conducted by Fantahun (2010) reported that large family size decreased the supply of malt barley in Amhara Region. Furthermore, study by Wolday (1994) showed that increase in household size had a negative and significant effect on quantity of maize marketed.

Access to credit (CREDIT): Access to credit was found to have a negative and significant impact on volume of wheat marketed at 1 percent significance level. The marginal effect result indicates that households who had access to credit decreased the

volume of wheat marketed by 84% compared to households who did not have access to credit. Households who had access to credit did not increase the volume of wheat supplied to market in order to cover their expenditure. Also, access to credit decreased probability of participation in wheat market (selling) by 4%. The result implies that farmers used credit to improve their financial capacity that enabled them to prioritize consumption over marketing. This result is in line with Amare's (2015) finding that access to credit affected the marketed surplus of pepper negatively. The result, however, contradict with Muhammed (2011) who pointed out that access to credit would increase marketed volume of wheat and *teff*.

Livestock holding: The coefficient of livestock ownership measured by tropical livestock unit with volume of wheat marketed was negative and statistically significant at 1 percent level. The marginal effect result revealed an increase in one unit of topical livestock unit would decrease intensity of volume of wheat marketed by 8 percent. This was due to the fact that households with large herd size (TLU) tend to allocate more land for grazing. The marginal effect indicates that increase in TLU owned would decrease probability of selling wheat by 0.4 %. Also, Rehima (2006) reported that increase in total livestock unit owned has a negative influence on quantity of pepper supplied to market.

Off-farm income: The coefficient of off-farm income for volume of wheat marketed is negative and statistically significant at 5 percent level. The marginal effect result indicates that increase in income from off- farm would decrease volume of wheat marketed by 6%. The marginal effect of probability shows that off-farm income decreases probability of selling wheat by 0.3% in line with the findings of Rehima (2006) and Adam (2010).

Oxen ownership: Coefficient for oxen ownership was found positive and significant 1% significance level. The marginal effect of intensity indicates that a one unit increase in oxen ownership would increase volume of wheat marketed by 31. Oxen ownership is critically in the context of the study area for timely land preparation that help produce marketable surplus. Similarly Tesfaw (2013) reported that the larger the numbers of oxen owned by a farmer, the greater the volume of products supplied to market by households.

Perception of farmers about wheat price: The estimated coefficient for perception of wheat market price is positive and significant at 5%. The marginal effect indicates that favorable households' perception about market price of wheat increase the volume wheat marketed by 7.26 quintals. Marginal effect of probability indicates households had a chance to sell their wheat produce at market price they want by 34%. The current finding is in line with a study conducted by Wolelaw (2005) and Adesiyan *et al* (2012).

4. Conclusion and Recommendation

Wheat is not produced only as a food crop by the majority of households in the district but also as a source of income. Therefore, the study focused on the amount of wheat sold to the market by smallholder farmers as well as identified the factors determining market supply of wheat by smallholder farmers.

The analytical finding shows that family size decreases volume of wheat marketed which indicates that large family members in households used wheat for home consumption rather than supplying to market. Therefore, intervention is needed in terms of teaching households on the benefits of family planning. It is obvious that most farmers do not balance their family size with their income levels. These situations aggravated the country's food insecurity problems. Therefore, strengthening family planning is required from the government side.

Households who had access to credit decrease volume of wheat marketed relatively to those who had not access to credit because they prefer to purchase inputs by credit they obtain rather than supplying wheat to the market. Without access to financial resources, farmers who had not accessed credit sold wheat immediately after harvest, when a price is at lowest point. In order to make farming profitable, government and non-governmental lending institution should make more effort to help solve liquidity constraint that smallholders face and encourage wheat producers to sell their produce when market price is fair for them. In addition, with limited access to credit, traders are often unable to purchase sufficient quantities of product to meet local supply need. Government and Non- governmental lending institution should improve access to credit for traders as well.

Involvement of households in off-farm income earning had a negative influence on the volume of wheat marketed as such income used to cover expenditure needs instead of selling the food crop. Therefore, government should encourage farmers to involve themselves in both activities to improve their livelihoods.

Furthermore, price of wheat was found to be positively related to marketed surplus. There should be a system for which suppliers could not fix price below some threshold limit. Government and other NGOs must stand besides farmers to safeguard them by offering fair (floor) price.

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6. Value Chain Analysis of *Rhamnus prinoides* (Gesho) in Central Zone of Tigray Regional State, Ethiopia

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Abstract

This study was designed to analayze value chain of *Rhamnus prinoides* (Gesho) in Ahferom District, Centeral Zone of Tigray Region.The specific objectives of this study were to identify the major gesho value chain actors and their roles; and quantifying costs and margins. The data were collected from both primary and secondary sources. The data were analyzed by using value chain analysis (chain mapping) and marketing margin estimation.The main value chain actors are input suppliers, producers, wholesalers, retailers, exporters and consumers. Producers are not formlly linked with different actors.Wholesalers govern the whole *Rhamnus prinoides* marketing system. There was high difference between producers' price and retail price in *Rhamnus prinoides* marketing resulting in low gross margin for producers. But, producers are doing all works of *Rhamnus prinoides* production and are bearing associated risks. *Rhamnus prinoides* producers incur the highest total cost in all channels, whereas retailers incur the lowest cost since they do not have transport costs. Producers' gross margin is highest in the shortest channel when they sell their product directly to consumers. However, the gross margin for producers is lowest in the longest channel since a number of middlemen are involved. Therefore, efforts are required to establish *Rhamnus prinoides* marketing cooperative to encourage collective action of farmers. There is also need for creating competitive market and promoting market intelligence to accelerate the development of pro-producers value chain for *Rhamnus prinoides* .

Keywords: Actors; market margin analysis; *Rhamnus prinoides* (Gesho); value chain analysis.

1. Introduction

Rhaminus prinoides, locally known as '*Gesho*', is a dicotyledonous angiosperm plant cultivated in Ethiopia. It is a shrub or tree which grows up to 6 meters and is also known to occur in Ethiopia, Botswana, Eritrea, Lesotho, Namibia, South Africa, Swaziland, and Uganda. The plat is exotic to Kenya; and also found in Cameroon, Sudan, and Angola (Digafie, 2010).

Ethiopian's *gesho* is one of the homestead cash perennial trees, mainly grown in Tigray Region, North Shoa of Amhara Region, Kara Kori and Sebeta of Oromia Region and Hadya Zone of SNNP Region. It is used for domestically brewed beverages such as *tella*, *tej* and also has several medicinal values and required for modern brewery in Ethiopia and other African countries (Afework and Bhagwan, 2012).

In Tigray Region, *gesho* is a good source of income for rural households'. In the region, there are large number of women whose livelihoods depend on processing *tella.* Besides,

due to the similarity of Ethiopian and Eritrean cultures and religions, it was highly tradable item to Eritrea before the Ethio-Eritrea conflict and currently (2015/16) traded via Sudan. This implies that gesho is potentially exportable to countries which have similar socio-cultural values and can generate foreign earnings for the country (Ahferom District Office of Agriculture, 2012).

In Ahferom district, most of the rural households are cultivating *gesho* and it is considered as the main cash perennial tree (Afework and Bhagwan, 2012). In the District, many smallholder farmers are engaged in *gesho* production. For instance, 19,480 quintals of *gesho* was produced in the 2014/15 production year (Ahferom District Office of Agriculture, 2014). According to Humera Custom and Revenue Authority (20140, 4,570.62 quintals of *gesho* were exported from Humera to Sudan in the year 2014/15. Hence, *gesho* production and trading is important source of income both for producers and traders in the research district.

Income and employment contribution of the tree for the society particularly for women and the rural economy has not been recognized and documented. As a result there has limited effort in terms of research and development for promoting, improving and developing gesho production and marketing. With regard to marketing, market actors and their roles, constraints and opportunities, costs and margins of each actor have not been analyzed. Generally, there is a gap regarding the value chain analysis of *gesho* in the district. Therefore, the current research was initiated to investigate the major *gesho* value chain actors, value chain governance, and costs and margins of actors.

2. Research Methodology

2.1. Description of the Study Area

Ahferom District (Figure 1) is found in Central Zone of Tigray Regional State. It is located between 14^0 06' 30" to 14^0 38' 30" North in latitude and longitudinally from 38^0 56' 30" to 39^0 18' East.

The study district is characterized by high population, rugged topography dominated by mountains and mixed farming system with small cultivated land and intercropping *gesho* with cereals (Ahferom District Office of Agriculture, 2014).

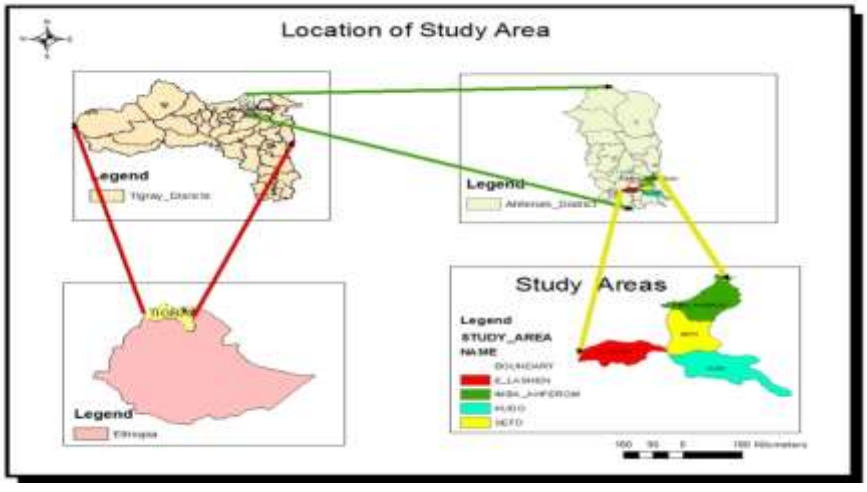

Figure 1. Geographical location of the study district.

2.2. Sampling Technique and Sample Size

Multi-stage sampling procedure was used to select sample *gesho* producer kebeles[3] and smallholder producers. In the first stage, in consultation with the districts of agricultural experts and development agents, out of 27 rural kebeles, 15 *gesho* producing kebeles were selected purposively based on the actual level of production. In the second stage, from the selected 15 rural kebeles, 4 sample kebeles were selected randomly. In the third stage, 132 sample households were selected randomly from the lists of gesho producer kebeles.

2.3. Data and Method of Collection

Both primary and secondary data sources and qualitative and quantitative data types were utilized for this study. Primary data were obtained from sample respondents by using semi-structured questionnaire through interview method. Before embarking on data collection, the questionnaire was pre-tested to check its appropriateness for gathering the required information. Four enumerators who speak the local language, *Tigrigna*, were recruited. Enumerators were trained regarding the contents of the questionnaire and data collection procedure. Trained enumerators interviewed the sample respondents under the continuous supervision of the researcher. Cross-sectional data on *gesho* market supply were collected. Moreover, to obtain preliminary information of the study area, Rapid Market Appraisal (RMA) technique was conducted with a number of stakeholders, who were believed to provide important information about the area in general.

Secondary data were gathered from Ahferom District Office of Agriculture, Humera Custom and Revenue Authority (HCRA), Ahferom District Office of Plan and Finance, and previous research findings and other published and unpublished materials.

2.4. Methods of Data Analysis

Value chain mapping and analysis was used for identifying chain actors at each stage and discerning their functions and relationships; determining the chain governance to facilitate chain formation and strengthening; and identifying value adding activities in the chain and assigning costs.

Marketing margin analysis was used to understand the estimated margin and cost components.

Calculating the total marketing margin is specified by:

$$\text{TGMM} = \frac{\text{Consumer price} - \text{Producers price}}{\text{Consumer price}} \times 100 \quad (2)$$

Where TGMM-Total gross marketing margin

$$\text{GMMP} = \frac{\text{Price paid by consumer} - \text{Marketing gross margin}}{\text{Price paid by consumer price}} \times 100 \quad (3)$$

Where GMMp- Producers' participation (farmers' portion)

3. Results and Discussion

3.1. Value Chain Actors and Their Roles

As illustrated in Figure 2, *gesho* value chain map encompass three main components i.e. value chain functions, main actors and value chain support institutions/enabling environments. The direct actors of the value chain are designated by boxes. These actors

[3]Kebele is the smallest administrative unit in Ethiopia

are generally vertical chain and are connected starting from input suppliers, producers, farmer traders, wholesalers, retailers, and consumers. The indirect actors that facilitate the main chain activities such as support institutions and enabling environments are also involved.

Gesho producers are the major actors who perform most of the value chain functions. The major activities that *gesho* producers perform include planting, cultivating, weeding, harvesting and post-harvest handling of g*esho.* Of the total *gesho* supplied by sample producers 56.1%, 34.9% and 9% were sold to wholesalers, farmer traders, and direct consumers channel, respectively.

Farmer traders are weekend traders who collect *gesho* from farmers mainly at district and rarely at local market for the purpose of reselling to wholesalers and consumers. Among the sample traders, 29.64% were farmer traders. They purchase *gesho* 11,366 kg (34.9%) from sample producers. Of the total *gesho* purchased, 91% was bought at the district market whereas the rest 9% was purchased at the local market. Farmer traders sold 64%, 30% and 6% to regional wholesalers', Humera wholesalers and direct consumers, respectively. All of the farmer traders were unlicensed and have capital limitation to perform trading activities.

Wholesalers buy *gesho* directly from producers and farmer traders in larger volume than any other actors and supply it to exporters and retailers. Among the sample traders, 33.36% of them were wholesalers and all were males. They were relatively well equipped with the necessary capital, facilities and knowledge as compared to other traders. Based on the type of selling, wholesalers were divided in to Regional and Humera wholesalers. The regional wholesalers were traders' to Mekelle, Aksum and Wukro. Of the total 28,954 kg purchased by wholesalers', 63.1% and 36.9% were supplied from producers and farmer traders, respectively. From the total *gesho* purchased by regional wholesalers, 48% was sold to Mekelle retailers, 23 % to Aksum retailers, and 29% was to Wukro retailers.

Humera wholesalers directly sold to exporters. There were four Humera wholesalers in the study district market and they purchased *gesho* from producers (20%) and farmer traders (30%). Humera wholesalers mix lower quality with high quality and sell at premium price. Wholesalers have better storage facility and have a better communication access than other traders. The selling and purchasing process is also undertaken often via customers' communication. The four wholesalers from Humera and six other wholesalers were licensed and these lincensed actors complain about the unlicensed wholesalers and the farmer traders.

Retailers are those who sell commodity to end users. Among the sample traders, 37% of them were retailers and 90% of them were women. Retailers are involved in the chain activities that include buying of g*esho*, transport to retail shops, grinding, displaying and selling to consumers. They are the last link between producers and consumers. Retailers also add value to *gesho* before consumption like grinding *gesho* for *tela.* Consumers usually buy the product from retailers as retailers offer according to quantity demanded. The retailors in the research area purchased 19,031.28 kg (58.43%) *gesho* from the regional wholesalers' and sell to consumers.

Exporters are identified in the district g*esho* market. They purchased from Humera wholesalers in the district market and exporting across Humera to Sudan. The amount of *gesho* exported was 30.4% of the total sampled market supply**.** *Gesho* is exported by Ethiopian exporters who came from Humera. The transaction system was via bill of exchange and through banks.

Consumers are those purchasing the products for consumption. In Figure 2, the end market/customers are indicated by rectangular box. *Gesho* consumers were identified such as local district *tela* processors, traditional beverage for holidays and ceremonies like

wedding, '*Christina* 'and memorial ceremony ('*Tezkar*' and '*Tsebel*') users. In general consumers have their own quality criteria and preference to purchase *gesho such as* thick drayed, light color leaves, free from soil and woods.

There are limited support service providers and the collaboration among them is weak. Ahferom Districts Office of Agriculture facilitates extension services and provide seedling through development agents for *gesho* production and Tigray Agricultural Research Institute (TARI) collaborates on providing research and community services on *gesho* diseases managements.

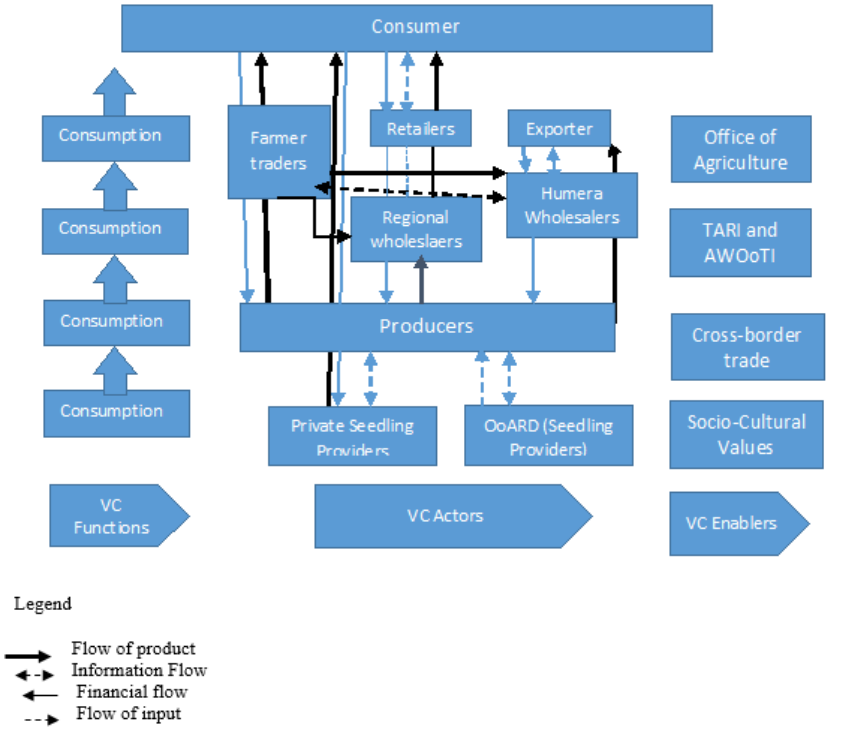

Figure 2. Value chain map of gesho

3.2. Value Chain Governance

Wholesalers have a power to regulate and fixes price of *gesho*. They regularly communicate in restaurants/cafes of the district and then fix the purchasing price. Besides, there is no vertical coordination between value chain actors but there is horizontal coordination between traders. Overall, the smallholder farmers are not organized and are not governing the value chain. There was also a complaint about 'unfair; custom and revenue taxation system and involvement of unlicensed traders in the market which results in lack of competitiveness for the licensed traders.

3.3. Gesho Marketing Channels, Costs and Margins

Market channels

Gesho marketing channels were drawn to provide a systematic knowledge on flow of goods and services from producers to the final consumers. In this study, producers supplied *gesho* to different channels within the same production year. *Gesho* marketing channels were grouped in to six categories based on the flow to the chosen alternative channel. In addition to this, channel comparison was made based on volume that passed

through each channel. Accordingly, channel V (Producers→Regional wholesalers Retailers→ Consumers) carry out the largest volume of supply accounting for 36.10% of the total supply. However, channel II (Producer→ Farmer traders→Consumers) carry out the lowest volume of supply which was 2.1%.

I. Producers → Consumers (2931Kg)

II. Producers → Farmer traders→ Consumers (682kg)

III. Producers→ Farmer traders→ Humera wholesalers → Exporters (3410.74 Kg)

IV. Producers→ Farmer traders → Regional wholesalers → Retailers →Consumers (7274 Kg)

V. Producers → Regional wholesaler→ Retailers → Consumers (11,756.67 Kg)

VI. Producers → Humera wholesalers → Exporters (6513.4Kg)

3.3.2. Marketing costs and margin analysis

Marketing Costs

Table 1, indicates that costs of different actors in each marketing channels. *Gesho* producers incurred the highest total cost in all marketing channels. Of the total cost incurred, 95.2% were costs of production and the rest 4.8% were marketing costs. In the study area road infrastructure is poor and the market place where *gesho* marketing takes place is far from the production area. Thus, g*esho* producers travel long distance from their residence to the district market to sell their product, and thereby incurred highest cost of transport or travel time. Channel I, V and VI producers sold their product only at the district market, while in channel II, III and IV small amount of *gesho* were sold at the local market. As a result, the transport cost was lower than the former three channels.

Regional wholesalers in channel IV and channel V incur the highest marketing cost than the other actors. The distribution centers of regional wholesalers were in different market places resulting in more transportation costs and other expenses. The major costs incurred by regional wholesalers were cost for packing material (sack) 21.73% and transport cost 19.75%. Similarly, Mahilet (2013) found that the major costs incurred by wholesalers were cost of transport and cost for packing material. Humera wholesalers incurred the highest cost in channel III and VI. But, they do not have transport cost since exporters covered the expenses. Retailers in channel IV and channel V also incurred lower cost than other actors because they did not have transport cost and with less other marketing expenses (retail shops).

Table 1. Estimated cost of actors in different marketing channel of gesho.

Market Actors	Costs per quintal (ETB)	Market channels					
		I	II	III	IV	V	VI
Producers	Labor cost to sell	35	20.6	20.6	20.6	35	35
	Transport cost	50	46	46	46	50	50
	Transport loss	16	12.1	12.1	12.1	16	16
	Packaging material	20	20	20	20	20	20
	Marketing cost	121	98.7	98.7	98.7	121	121
	Production cost	2398	2398	2398	2398	2398	2398
	Total cost /qt	2519	2496.7	2496.7	2496.7	2519	2519
Farmer traders	Labor cost to sell	-	45	45	45	-	-
	Transport cost	-	6	14	14	-	-
	Transport loss	-	18	21.25	21.25	-	-
	Packaging material	-	20	20	20	-	-
	Packing cost	-	15	15	15	-	-
	Total cost /qt	-	104	115.25	115.25	-	-
Humera wholesalers	Labor employed to sell	-	-	33	-	-	33
	Packaging material	-	-	40	-	-	40
	Packing cost	-	-	15	-	-	15
	Loading and unloading	-	-	10	-	-	10
	Transport cost	-	-	0	-	-	0
	Telephone cost	-	-	10	-	-	10
	Storage cost(rent)	-	-	15	-	-	15
	Storage loss	-	-	45	-	-	45
	Tax	-	-	10	-	-	10
	Total cost /qt	-	-	178	-	-	178
Regional Wholesalers	Labor cost to sell	-	-	-	17.5	17.5	-
	Transport cost	-	-	-	44	44	-
	Transport loss	-	-	-	16	16	-
	Storage loss	-	-	-	16.5	16.5	-
	Packaging material	-	-	-	40	40	-
	Packing cost	-	-	-	15	15	-
	Loading and unloading	-	-	-	10	10	-
	Telephone cost	-	-	-	2	2	-
	Storage cost(rent)	-	-	-	15	15	-
	Storage loss	-	-	-	14.25	14.25	-
	Tax	-	-	-	10	10	-
	Total cost /qt	-	-	-	200.25	200.25	-
	Storage loss	-	-	-	17.6	17.6	-
	Storage rent	-	-	-	46	46	

	purchasing plastics	-	-	-	20.8	20.8	
Retailers	Tax	-	-	-	10	10	-
	Total cost /qt	-	-	-	94.4	94.4	-

Source: Authors computation.

Market margin analysis

Market margins of *gesho* value chain actors were analyzed in six marketing channels (Table 2). GMM_P, GMM_F, GMM_{HW}, GMM_{Rw} and GMM_R represents gross marketing margins of producers, farmer traders, Humera wholesalers, Regional wholesalers and retailers, respectively. The highest total gross marketing margin of traders was in channel IV, V and VI which were 40%, 34.24% and 25.62%, respectively. Humera wholesalers have got the highest gross marketing margin in channel VI which is 25.62% since they sold directly to exporters at premium price with less involvement of middle men. On the contrary, farmer traders got the lowest marketing margin in channel II, III and IV, which is 5.74%. This is because farmer traders purchase and sell mainly at the district market with minimum difference in price due to high competition with wholesalers.

In channel I producer's share was highest because they sold their product directly to consumers. Without considering Channel I, GMMp was better in channel II, III, VI, and V which were 94.26%, 78.31%, 74.38%, and 65.76%, respectively. But, it was lowest in channel IV which was 60%. The share of producers diminishes due to involvement of a number of actors in the market channels.

Table 2. Marketing margins of actors in different marketing channel of *gesho*.

Actors	Prices and Margins (ETB)	Market channels					
		I	II	III	IV	V	VI
Producers'	Selling Price/qt	3402	3054	3054	3054	3347	3347
Farmer	Price/qt	-	3240	3240	3240	-	-
traders	GM/qt	-	186	186	186	-	-
	$\%GMM_F$	-	5.74	5.74	5.74	-	-
Humera	Price/ qt	-	-	3900	-	-	4500
Wholesalers	GM/ qt	-	-	660	-	-	1153
	$\%GMM_{HW}$	-	-	16.92	-	-	25.62
Regional	Price/ qt	-	-	-	3990	4000	-
Wholesalers	GM/ qt	-	-	-	750	653	-
	$\%GMM_{RW}$	-	-	-	18.80	16.33	-
	Price/ qt	-	-	-	5090	5090	-
Retailers	GM/ qt	-	-	-	1100	1090	-
	$\%GMM_R$	-	-	-	21.61	21.41	-
%TGMM		0	5.74	21.69	40.00	34.24	25.62
% GMM_P		100	94.26	78.31	60.00	65.76	74.38
Rank of channels by producers' share		1	2	3	6	5	4

Source: Authors computation.

4. Conclusion and Recommendations

1. In the study district *gesho* producers are small-scale farmers, unorganized and not formally linked with other actors. Therefore, there is a need to establish *gesho*

marketing cooperative by District Office of Agriculture to encourage collective action of farmers.

2. In the study area, *gesho* value chain governance is wholesalers driven. As a result, *gesho* producers were complaining about wholesalers' action due to lower price setting and cheating while weighting their produce. Therefore, District Office of Trade and Industry should regulate illegal price setting by wholesalers and attract other traders to enter in to *gesho* trading in order to make the market more competitive.
3. The study indicated that there is a high difference between producers' price and retail price in *gesho* marketing resulting in low gross margin for producers. But, producers are doing all works of *gesho* production and are bearing associated risks. Therefore, there is also need for creating competitive market and promoting market intelligence to accelerate the development of pro-producers value chain for *Rhamnus prinoides.*

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7. Value Chain Analysis of Hot Pepper (*Capsicum annuum*): A case Study in Northwestern Ethiopia

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Abstract

With the increasing transformation of the agriculture economy towards global market competition, investing on development of the horticultural sector value chain in surplus producing areas is a dominant strategy. This research was carried out at Jabitehinan District, Northwestern Ethiopia to map hot pepper value chains, identify the added values along the chain, analyze marketing margins, and examine the role of different value chain actors. Relevant data were gathered using questionnaire administered on 97 traders (value chain actors) and analyzed using descriptive statistics. From the total 39,544 qt of pepper produced in the district, 7,513qts was transacted via value chain actors. Following the commodity's route, 10 marketing channels were identified. The result indicated that the commodity's value chain is governed by wholesalers. Markets were found to be inefficient with wide margins and oligopoly in structure. The highest gross marketing margin was taken by '*baltinas*' (70.83%) and the minimum being that of farmer traders (5.5% of the consumers' price). Similarly, the highest and lowest net marketing margins were 67.37% and 0.5% of the consumers' price which are taken by '*baltinas*' and farmer traders, respectively, and hence, in terms of the price spread, markets were found to be inefficient. Setting standards to the commodity reduces the price risks at every of the value chain actor. Intervening on value chain financing and arranging contractual agreements between producer farmers and responsible stakeholders would foster development of the commodity's value chain with sustainable production and risk free markets.

Keywords: 'Baltinas'; efficiency; value chain governance; margin.

1. Introduction

Pepper is one of the most reputable cash crops produced by smallholder farmers in many low and mid-altitudes of Ethiopia. Areas like western Gojjam (Jabitehinan, Burie and Shindi districts), eastern and southern Shewa, western and northwestern Wellega, and the southern Ethiopia (Alaba and the Mareko) are potential producers of pepper in Ethiopia. According to CSA (2008), the estimated production of hot peppers at the national level, in the Amhara Region, and West Gojjam zone were 122,399.7, 37,039.3, and 12,026.9 tons, respectively. In Ethiopia, pepper is consumed in different forms and it is a component of almost all foodstuffs. It is unlikely to see Ethiopian traditional meals consumed devoid of pepper (Roukens, 2005). However, poor marketing practices, price instability, and poor handling practices are prevailing problems that discourage producers. There are no value chain development interventions that have been made so far to commercialize the commodity. Thus, producer farmers fear low prices and tend to invest on another crop. The problem in turn results in supply shortage in different areas

of consumption. Hence, working on value chain development of hot pepper should be a priority agenda for improving the supply and satisfying the market demand of consumers. In order to improve value chains of the commodity, the role of market-actors, market channels and the existing constraints and opportunities along the chain need to be identified. The specific objectives of the study, therefore, include mapping hot pepper value chains, identifying the contributions of each actor in the chain and the possible market channels of the commodity, and examining the role of different market actors along the value chains.

2. Materials and Methods

2.1. Description of the Study Area

Jabi Tehinan is one of the 15 districts of West Gojjam administrative zone. It is found 374 kms Northwest of Addis Ababa and 171.7 kms southwest of Bahir Dar, the Regional State capital. The district covers a total of 117,020 hectares. Currently, the district is divided in to 37 rural Kebele administrations (KAs) and 3 towns. Finote Selam, Mankusa and Jiga are the major towns in the district.

The climate of the district is in general 88% *Weina Dega* (mid-altitude) and 12% *Kola* (lowland). The average annual rainfall of the district is 1250mm. The Western and Northern parts of the district receive relatively higher rainfall compared to other parts of the district. The district has mono-modal rainfall distribution and extends from May to September. Maize, *teff,* and wheat are the major crops in the district.

Topographically, the district is classified as plain land (65%), terrain (15%), valley (15%) and unclassified land (5%). Altitude of the district ranges from 1300 to 2300 masl. The mean annual temperature ranges from 14^{o}C to 32^{o}C. Three soil types, namely black (15%), red (60%), and brown (25%) are predominant in the district. When the soil fertility is considered, it is classified as 27% fertile, 71% medium fertile, and 2% degraded land.

2.2. Methods of Data Collection

Data such as production area, output, number of pepper traders, and price of pepper were taken from secondary sources. Secondary data sources include the district Office of Agriculture and other nationally published data.

Primary data were collected from individual households and concerned organizations with an interview schedule. The data were collected through individual interviews. Primary data were gathered from pepper traders, intermediaries of the market chain, concerned government officials, and non-government bodies. Informal methods of data gathering (group discussion with key informants and Rapid Market Appraisal) were also employed.

In order to generate primary data, a total of 97 pepper traders were selected using a two stage random sampling method. In the first stage, market centers were selected purposively based on their pepper supply potentials. In the second stage, based on proportion of traders in each market center, the total sample size (97) was proportionately shared among these market centers and respondents were taken at random. Respondents taken from each marketing actors (farmer traders, wholesalers, assemblers, retailers and other marketing actors) are as shown in Table 1.

Before the beginning of data gathering through interviewing, a three days training was given to 4 enumerators. These enumerators were frequently supervised and the required data from the producers were gathered using a pre-tested interview schedule. For the traders, rapid market appraisal (RMA) with group discussion, key informant discussions, and direct observation was undertaken along the market chain in order to acquire

different ideas and diverse viewpoints of traders from different corners.

2.3. Methods of Data Analysis

For analyzing the collected data, means, percentages, variances, standard deviations, and ratios were used to examine the relevant variables under consideration. The specific indicators quantified were as explained below.

Structure Conduct Performance (S-C-P) Model

This model investigates market structure, market conduct, and performance. This model has been used by different market researchers to address their objectives (Tamek and Robinson, 1990).

Market concentration measure

According to Tamek and Robinson (1990), concentration ratio refers to the number and relative size of buyers in the market. The concentration of firms in the market is estimated using the common measure of market concentration ratio. Concentration ratio is one of the commonly used methods to measure market structure. It is given as:

$$C = \sum_{i=1}^{4} S_i \quad (1)$$

Where C is the four firm concentration ratio; S_i is the percentage market share of the i^{th} firm for the largest four firms (i=1,2,3,4).

As noted by Kohls and Uhl (1985), concentration ratio of 50% or more is an indication of a strongly oligopolistic industry, 33-50 % a weak oligopoly and less than that is a competitive industry.

Marketing margin

Marketing margin is the difference between the price received by producers and paid by consumers (Tamek and Robinson, 1990). According to Cramer and Jensen (1982), marketing margin is the percentage of the final weighted average selling price taken at each stage of the marketing chain. The total marketing margin is the difference between what the consumer pays and what the producer/farmer receives for his product. In other words, it is the difference between retail price and farm price (Mendoza and Rosegant, 1995).

Computing the total gross marketing margin (TGMM) is always related to the final price paid by the end buyer and is expressed as percentage (Mendoza and Rosegant, 1995).

$$TGMM = \left[\frac{\text{Consumer Price - First Seller Price}}{\text{Consumer Price}}\right] \times 100 \quad (2)$$

Where, TGMM is Total gross marketing margin.

It is useful to introduce the idea of farmer's portion' or producer's gross margin' (GMMp) which is the portion of the price paid by the consumer that goes to the producer. The producer's margin is calculated as:

$$GMM_p = \left[\frac{\text{Consumer Price - MarketingGross Margin}}{\text{Consumer Price}}\right] \times 100 \quad (3)$$

Where, GMMp is the producer's share in consumer price.

The net marketing margin (NMM) is the percentage of the final price earned by the intermediaries as their net income after their marketing costs are deducted. Thus, the net marketing margin is calculated as:

$$NMM = \left[\frac{\text{Gross Margin - Marketing Costs}}{\text{Consumer Price}} \right] \times 100 \quad (4)$$

Where NMM is the net marketing margin.

3. Results and Discussion

3.1. Characteristics of Pepper Traders and Channel Analysis

3.1.1. Type and description of pepper traders

Along the marketing chain, there are a number of marketing actors who handle the commodity at different stages in the process of transaction. They together form the link and create the channel beginning from producers until the commodity reaches to the ultimate consumers. These different groups of pepper traders include wholesalers (regional), assemblers (regional and urban), farmer traders (village collectors), and processors (pepper millers and '*baltinas*'). Regional wholesalers are those pepper wholesalers who reside in regional towns, not in the capital city; and urban wholesalers are those wholesalers who live in and work in the capital city (Addis Ababa). The result indicated that there was a significant difference among traders in terms of the socio-demographic characteristics like sex, age, education level, and years of experience at probability levels of 10%, 5% and 1%, respectively.

Farmer traders

These are generally seasonal traders who actively participate in times of high supply and shift to other farming businesses when market supply of pepper vanishes. The informal survey result revealed that on average, farmer traders had about 4 years of experience in pepper trading. From the total of farmer traders with whom group discussion was made, 54% of them did not have trade license. The main objective of farmer traders is to handle large volume of purchased pepper for supplying to wholesalers at better prices (as wholesalers are willing to pay better when they obtain large amount of pepper timely).

Wholesalers

Wholesalers handle large volume of pepper which are bought from producers directly, farmer traders, or regional assemblers. They frequently transport their pepper to the terminal market (Addis Ababa) using trucks (Isuzu). With their better knowledge and trading experience, they had close relationships with their agents in regional markets who collects large volume of pepper from different areas of surplus. According to the information obtained, the largest portion of the purchase of regional wholesalers was also sold to wholesalers in the terminal market.

Table 1. Sample size of traders.

KA/Town	Wholesalers	Assemblers	Retailers	Farmer traders	*Baltinas*	Pepper Millers
Mankusa	2 (2)	3 (4)	6 (14)	11 (16)		
Finote Selam	3 (4)	4 (7)	8 (17)	9 (22)		
Jiga	2 (2)	4 (6)	7 (13)	12 (11)		
Addis Ababa (Merkato)	6 (11)	3 (9)	10 (29)		3 (5)	4 (8)
Total	13(19)	14 (26)	31 (73)	32 (49)	3 (5)	4 (8)

Note: Numbers in the parenthesis are existing population size of traders.

The informal survey result also indicated that urban wholesalers had a trading experience of about 10 years on average.

Assemblers

These marketing participants buy pepper for storing and selling when demand is better and price is high. Assemblers in regional markets sell their pepper to regional wholesalers when market supply vanishes. They are well experienced in pepper trading (about 5 years of experience on average) and know the best time of selling.

'Baltinas'

Baltinas are processors who sell pepper at relatively high prices after they add value to it. They are very strategic in buying that they try to accommodate and satisfy their demand by purchasing pepper at the peak time of surplus from different potential sources of pepper in the country. They prefer buying the commodity from these regions at the farm gate and transport their purchased amount using their own vehicles.

3.1.2. Price setting strategy of Baltinas and pepper mill owners

The informal survey result revealed that *baltina* shops do not have the power to set the purchase price and they do not want to interfere with the price setting strategy of wholesalers. Rather, relying on the price which is set by wholesalers, they purchase most of their pepper directly from producers aiming at the product's quality and quantity. *Baltinas* are very systematic in identifying the areas of surplus and particular season at which price reaches its minimum.

They determine the selling price by considering all marketing costs and the costs incurred in the process of value addition of the pepper. According to the information obtained, *baltinas* prepare about 51 types of value added items (condiments) which costs high per kilogram of output.

As the information obtained from the informal survey revealed, pepper mill owners do not have the power to set the purchase price of pepper as their suppliers are urban wholesalers who have the power to set the selling price of pepper. However, they bargain in terms of quality of the pepper to buy less quality pepper at low prices since their objective is to sell the ground pepper where quality detection is difficult to buyers. About 30% of retailers confirmed that the ground pepper they bought from these millers was the product of low quality processed pepper.

3.2. Marketing Channels of Hot Pepper

Based on the direction of flow and volume of pepper transacted, ten marketing channels were identified. The channel starts from the producers and ends in the terminal market (except *baltinas*) passing through a number of marketing actors along the chain. According to the district BoARD (2009) report, a total of 39,544 qt of pepper was produced in the year 2008/09. Of this, the amount that was transacted during the year was found to be 7,513qts. Because of the special nature of the commodity, the flow channel was found to be long and complicated. In order to quantify the volume of pepper handled by each marketing actor along the marketing chain, the total purchased amount was multiplied by the share of each marketing actor as obtained from the survey. This work is in line with Kindie (2007) and Rasmus (2001).

Table 2. Socio-demographic characteristics of pepper traders.

Trader type	Sex (% of male)	Age (years)	Experience (years)
Farmer trader (N=32)	100	34.69 (5.08)	4.12 (4.24)
Regional wholesalers (N=7)	85.71	28.43 (2.76)	9.86 (4.37)
Urban wholesalers (N=6)	100	31.33 (4.59)	9.67 (1.63)
Regional assembler (N=11)	100	32.18 (5.46)	4.82 (1.40)
Urban assembler (N=11)	100	26.33 (2.08)	7.00 (1.00)
Regional retailers (N=21)	85.71	33.95 (6.23)	5.14 (2.13)
Urban retailers (N=10)	70.00	35.00 (9.83)	10.30 (2.67)
Baltinas (N=3)	100	47 (4.58)	7.00 (1.00)
Pepper millers (N=4)	100	44.00 (4.69)	10.5 (1.29)
Total (N=97)	92.78	33.85 (6.55)	6.22 (3.13)
F/ χ^2-Value	14.43*	3.62***	16.49***

Note: *** and * show statistical significance at less than 1 and 10% probability levels; Numbers in the cells are mean and standard deviations; N=Sample size.

Following the channels depicted in Figure 1, the following marketing channels were identified.

Channel I. Producer→ Regional wholesaler → Urban wholesaler → Retailer → Consumer

Channel II. Producer → Regional wholesaler → *Baltinas*→ Retailer → Consumers

Channel III. Producer→Farmer trader →Regional wholesaler→Urban wholesaler →Retailer →Consumer

Channel IV. Producer →Regional Assemblers →Regional wholesaler →Urban wholesaler→ Retailer → Consumer

Channel V. Producer → Urban assemblers → Retailer → Consumer

Channel VI. Producer → Urban wholesalers → Millers → Consumer

Channel VII. Producer →Regional wholesaler → Regional retailers → Consumer

Channel VIII. Producer → Regional retailers → Consumers

Channel IX. Producer → Consumer

Channel X. Producer → *Baltinas* → Retailer→ Consumer

Regional wholesalers are those traders who reside in regional towns, not in the capital city and urban wholesalers are wholesalers who live in and work in the capital city (Addis Ababa).

3.3. Market Structure and Performance of Hot Pepper

Before discussing about structure and performance, some descriptive results about the different actors and the pepper value chain map are presented. Difference in level of education of the actors are presented in Table 3 below.

Education lays a basic ground to involve in pepper trading. The survey result indicated that the education level of traders was by far better than that of producer farmers and it was those individuals who had better education background relative to others who become pepper traders. Thus the role of education in changing producers' attitude towards increasing the level of market participation is vital.

Table 3. Education level of traders (%).

Education level	Farmer traders (N=32)	Regional assemb. (N=11)	Urban assemb. (N=3)	Urban retailers (N=10)	Regional wholesales (N=7)	Urban wholesalers (N=6)	Millers (N=4)	χ_2
Read and write	50	27.3	0	70	28.6	50	0	
Grade 1-4	9.4	9.1	33.3	10	28.6	16.7	0	
Grade5-8	12.5	0	66.7	0	28.6	0	0	
Grade9-12	28.1	36.4	0	20	14.3	33.3	50	81.90***
Above grade 12	0	9.1	0	0	0	0	50	
Religious school	0	9.1	0	0	0	0	0	

*Note: *** shows statistical significance at less than 1% probability level; N=Sample size.*

As indicated in Figure 1, large proportion of the product (43%) of farmers was sold to regional wholesalers followed by to farmer traders (10%).

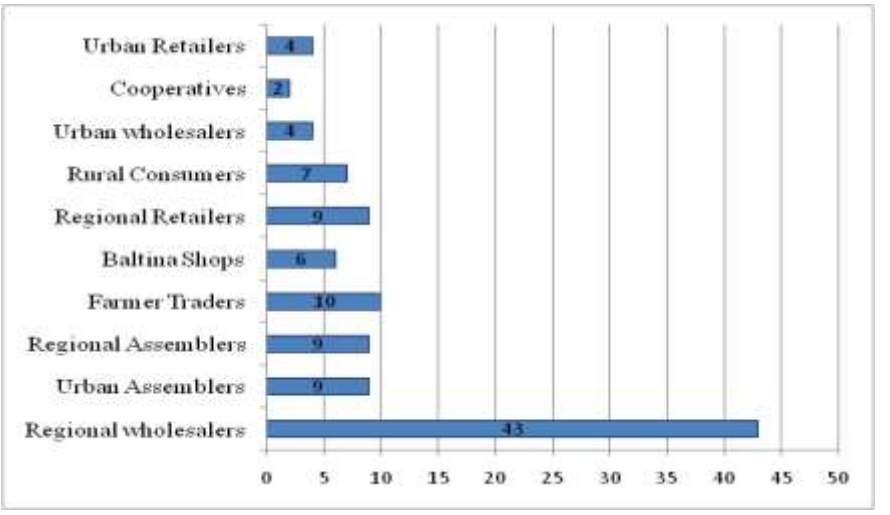

Figure 1. Proportions of value of product sold by farmers to the different actors (%).

About 76% of farmer traders and 53% of regional wholesalers confirmed that the amount of initial working capital was one of the main barriers to enter pepper marketing. Due to lack of own capital and incapability of traders to take credit from micro finances, many are prohibited from being involved in the pepper trade. The survey result showed that out of the total sample of farmers interviewed, 22.5% asked credit and only 18.33% were able to take credit.

Because of the absence of training on pepper trade in terms of the transaction of the commodity with reasonable prices and market legalities, many farmers do not have clear understanding about pepper trading although they had sufficient initial capital to start the business. The survey result showed that about 98% of farmer traders, 91% regional wholesalers, 69% of urban wholesalers and 83% of urban retailers have a strong interest to enhance their knowledge of pepper trading from training.

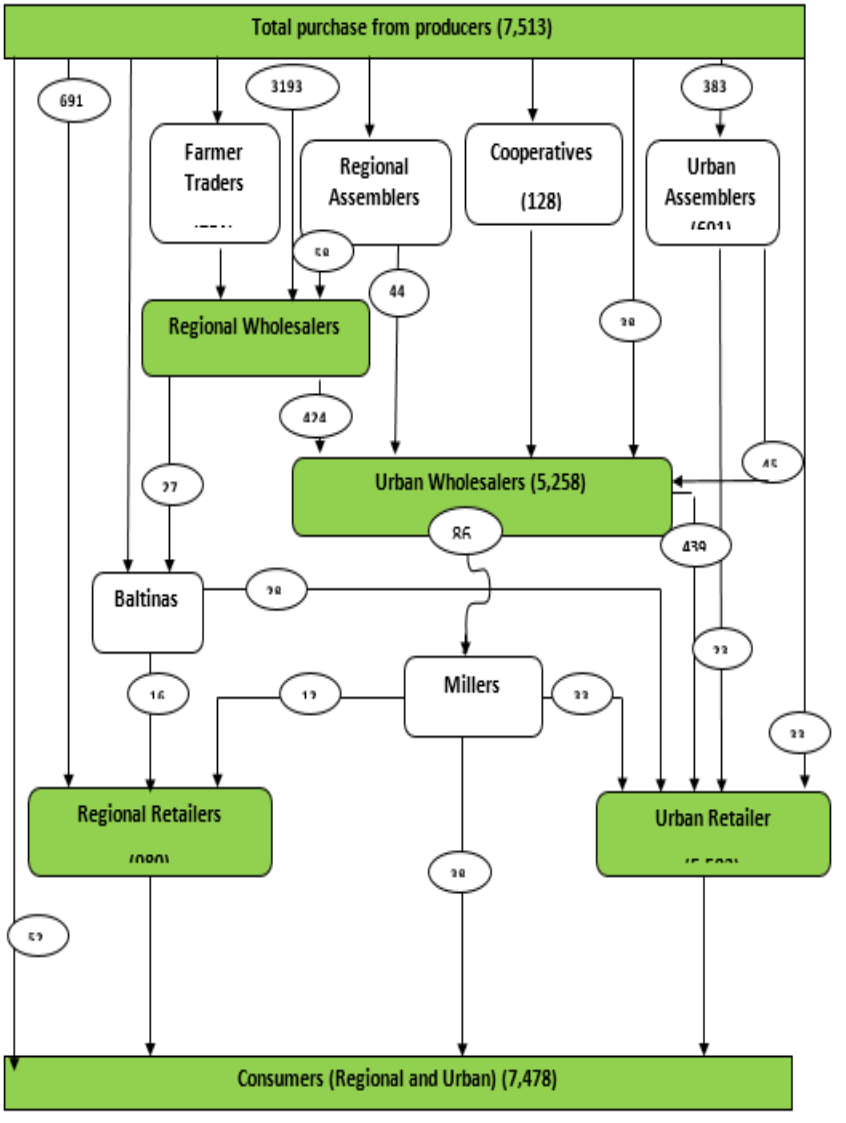

Figure 2. Map of hot pepper value.
chain

Note: Numbers in the figure represent volumes of pepper in quintals.

Table 4. Average marketing costs of traders (Birr/qt).

Cost	Farmer Traders	Regional Wholesale	Urban Wholesale	Urban Retailers	*'Baltinas'*
Sack	8.00	7.00	6.42	7.00	7.00
Loading	6.00	8.00	7.50	7.00	7.00
Unloading	2.00	3.00	4.00	2.00	2.00
Car	8.00	10.00	32.00	13.0	22.00
Cart	15.00	12	-	-	-
Brokerage	15.00	20.00	22.00	5.00	5.00
Carrying	8.00	-	-	-	5.00
Electricity	-	3.00	2.00	-	6.00
Grading	7.00	8.00	8.40	9.00	14.00
Wage	18.00	23.00	20.00	-	12.00
Storage	8.00	14.00	7.00	6.55	10.00
Store loss	18.00	19.00	26.00	4.00	3.00
Guard	11.50	9.50	11.00	5.00	11.00
Telephone	6.00	6.00	4.50	2.00	3.50
Personal expense	15.00	17.50	22.00	13.24	7.0
Total	145.5	160	173.47	70.79	124.5

Though clear market information is fundamentally important in pepper trading (IPC, 2009), producers are the number one who suffered from the problem of accessing the current price information (especially the terminal market price). However, farmer traders exchange price information with their clients (wholesalers, assemblers, and the middlemen) through phones (especially mobile phones) and by oral means of communication. In Jabi Tehinan district, 81.7 % the total interviewed farmers had local market price information but those who had the terminal marker price information were found to be only 22.5%. Producers' and traders generally had strong desire for market information. As the information obtained from the informal survey indicated, about 65% of farmer traders were willing to pay for price information.

Of the total sample of farmers taken, 36.67% got the local market price information by self-assessment, 21.67% by telephone (mobile), 12.5% by asking from traders and 6.7% through radio. Similarly, 8.3% of producers obtained the Addis Ababa market price information using radio, 5.8% through mobile, 5% through brokers, 1.7% by asking traders, 1.7% through television, and only 0.8% by self-assessment.

Table 5. Marketing margins along the different marketing channels.

Marketing margins	Marketing channels									
	I	II	III	IV	V	VI	VII	XIII	IX	X
TGMM	71.07	76.67	73.10	71.90	53.93	62.54	35.80	67.51	28.26	70.83
GMMft			5.5							
GMMrws	12.45	10.73	12.45	10.34						
GMMuws	48.95		58.62	58.62		32.47		13.79		
GMMra				10.61						
GMMua					13.89			10.96		
GMMrrt							35.80			
GMMurt	37.93		13.79	12.41	31.54			12.62		
GMMbal		66.67								70.83
GMMmill						50.70				
GMMprod	28.93	23.30	26.90	28.10	46.06	37.45	35.80	32.49	100	26.25
NMMft			0.52							
NMMrws	6.94	6.28	6.94	11.67						
NMMuws	49.48		52.64	52.64		28.07				
NMMra				5.16						
NMMua					12.45					
NMMrrt							26.80	5.85		
NMMurt	35.49		11.35	9.97	28.08					
NMMbal		63.21								67.37
NMMmill						47.23				

Note: TGMM is total gross marketing margin, NMM is net marketing margin, ft is farmer traders, uws is urban wholesalers, rws is rural wholesalers, ra is rural assemblers, ua is urban assemblers, rrt rural retailers, urt is urban retailers bal is baltinas, and mil is millers.

Nevertheless, the price information is not equally accessible to all actors. According to the rapid market assessment information obtained from farmer traders, about 65% of them on average had no information on the daily price in Addis Ababa. These traders who did not access the daily market information buy pepper using the price of the previous market day as a reference, which might lead them in crisis if price declines the following day.

3.4. Market Concentration

Degree of market concentration in Finote Selam and Addis Ababa showed that pepper is handled by few individuals and thus the pepper market is oligopolistic in nature. In the above regional markets, the 2008/9 annual volume of pepper purchased was taken in order to calculate the concentration ratio in the markets considered (Finote Selam, and Addis Ababa).

The concentration ratio had indicated the existence of oligopoly market structure in the three markets considered in different degrees (Table 6).

In Addis Ababa, 4 relatively large wholesalers had a share of about 67.41% indicating a strong oligopoly market structure and a weak oligopoly for regional wholesalers in Finote Selam that took 57.82% of the annual volume of pepper purchased. Of the total volume of purchased pepper, urban retailers in Addis Ababa took 41.15%, which is also an indication of weaker oligopoly in the terminal market than in regional markets.

Table 6. Concentration ratio of the pepper markets considered.

Markets	Concentration ratio for the four big firms (%)
Finote Selam (Regional wholesalers)	57.82
Addis Ababa (Urban retailers)	41.15
Addis Ababa (Urban wholesalers)	67.41

3.5. Marketing Performance

Marketing costs and margin analysis

In the process of pepper trading, each marketing actor incurs costs as in Jema (2008). Table 5 shows the average marketing costs incurred by every actor during transaction. The highest marketing cost was incurred by the urban wholesalers (173.47 birr/qt) followed by regional wholesalers (160birr/qt). This is because the primary packing materials are used by these regional wholesalers and specialized labor for the grading, packing, loading and unloading is relatively expensive in the terminal market than in the regional towns. On the other hand, due to the absence of transport, urban retailers incurred the smallest marketing costs (70.79birr/qt) followed by pepper millers (112.5 birr/qt). Transport cost was the number one cost for urban wholesales, urban assemblers, regional wholesales, regional assemblers, *baltinas* and pepper millers since they had to ship large volume of the purchased pepper from distant markets.

The next highest cost incurred by all marketing actors (except urban retailers, pepper mill owners, and *baltinas*) was the loss during storage. Due to the addition of large amount of water in the different chains of the transaction process, significant amount of weight loss happens. A similar finding done by Rehima (2006) showed that storage loss was the main marketing cost incurred in the process of trading the commodity. The next highest cost common to all traders was the cost of packing material (plastic sacks). Brokerage costs are also major costs incurred for handling large purchases.

The marketing margins calculated for each marketing actor show that there is a large difference in the consumers' price spread along the marketing chain. Wider marketing margin indicates high price to consumers and low price to producers and it is an indicator of the existence of imperfect markets (Cramer and Jenson, 1982) though markets may fail due to many reasons.

Total gross marketing margin was maximum (76.67%) in channel II followed by Channel III (73.10%), the minimum was in Channel IX (28.26%). The result also showed that the maximum gross marketing margin was taken by *baltinas, i.e.*, 70.83% of the consumers' price in Channel X and 66.67% in Channel II. Pepper millers took the next highest gross margin (50.70%) in Channel VI followed by urban wholesalers (48.95%) in Channel I. The least (0.52%) was taken by farmer traders (Table 7).

The highest net marketing margin (67.37% and 63.21% of consumers' price) was taken by '*baltinas'* in Channel X and Channel II, respectively. The minimum net marketing margin (5.16%) was taken by regional assemblers in Channel IV. These big marketing margins taken by different marketing actors are evidences for the existence of market inefficiencies although high marketing margins can also arise due to high real marketing costs and a very big producer and consumer price differences. This result is in line with Cramer and Jenson (1982).

Table 7. Marketing profit of pepper traders (Birr/qt) for selected channels.

Marketing agents		Marketing Channels					
		I	II	III	IV	V	X
Farmer traders	Purchase price			678.2			
	Marketing cost			145.5			
	Selling price			838.8			
	Marketing profit			15.16			
Regional wholesalers	Purchase price	838.86	838.8	838.8	900		
	Marketing cost	160	160	160	160		
	Selling price	1200	1225	1200	1200		
	Marketing profit	201.14	226.1	201.1	140		
Urban wholesalers	Purchase price	1200		1200	1200		
	Marketing cost	173.47		173.4	173.4		
	Selling price	2635		2900	2900		
	Marketing profit	1261.53		1526.	1526.		
Urban retailers	Purchase price	1800.00		2500.0	2540	1400	
	Marketing cost	70.79		70.79	70.79	70.79	
	Selling price	2900.00		2900.	2900	2045	
	Marketing profit	1029.21		329.2	289.2	574.2	
'*Baltinas*'	Purchase price		1200				1050
	Marketing cost		124.5				124.5
	Selling price		3600				3600
	Marketing profit		2275				2425

The difference between the total income from pepper trading and the costs incurred in the process of pepper trading gives the marketing profit of traders. As depicted in Table 7, the highest marketing profit was taken by *'baltinas'* (2,425.5 birr/qt in channel X 2,275.5 birr/qt in Channel II). The next marketing actors who earn highest profit next to the '*baltinas*' are pepper mill owners (1,533.04 birr/qt). Because of the value that they add to the commodity (form utility), these two marketing actors were able to take the highest profit in the marketing chain.

Urban wholesalers are the next marketing actors who took the highest profit (1,396birr/qt and 1261.53 birr/qt in Channel III/IV and I, respectively) as they receive the terminal market retail price directly. They are also the one who are strategic in setting relatively higher prices in the terminal markets that help them earn high profit. Urban retailers, who are the final suppliers of urban consumers, took the profit ranking third among the marketing actors, which is 1029.21birr/qt in Channel I.

Regional wholesalers took the lowest marketing profit (140birr/qt) in Channel IV. An informal discussion with regional wholesalers confirmed that the unpredictable price decline had been one of the major problems, which determined their profit. According to the information obtained, there were cases by which they sold their total purchase even below the purchase price. In addition, in regional markets, wholesalers are highly competed by retailers and farmer traders and they usually pay high brokerage cost in order to handle large purchase volume. Generally, the profits earned by these different marketing actors are the reflections of high marketing margins.

3.6. Opportunities and Major Challenges

3.6.1. Opportunities

High production potentials: Jabitehinan district is one of the potential surplus source of hot pepper in Ethiopia and ranks first from Gojjam areas. This area is known for its sustainable production and supply of hot pepper that take the majority of hot pepper supplied to the terminal market by the Amhara Region.

Small areas needed: Another merit is the possibility of producing the commodity in a relatively small areas of land in contrast to land allocated for other cereal and legume crops. With increasing population and per capita land holdings, advocating such high value crops calls serious attention.

Increasing international market demand: Increasing demand at international national markets is favoring producers. However, the challenges reflected during the transaction process need urgent interventions.

Focus given by the government: In recent years, the Ethiopian government has given better focus towards intensification of the horticulture industry including subsidy and tariff incentives.

3.6.2. Major challenges

Unstable prices: Prices are highly fluctuating that frustrate producers and make them loss trust for future production

Asymmetric information: Producer households do not have timely price information and lack bargaining power. There is no transparent system in the transaction process as the commodity's value chain process lacks clear cut standards, product differentiation,

and appropriate value upgrading. This helps traders highly benefit at the expense of producers.

Absence of defined standards: There is no defined standards for the commodity to fix a given level of price. This is especially disfavor producers.

Insufficient input available: Shortage of better performing varieties that are well adapted to the local environment.

Poor product handling: Poor handling and absence of the expected value additions along the chain is also a major challenge. These include addition of water on the product (for increasing weight and making the commodity more attractive looking). This results in deterioration of the commodity because of mould development (loss of pungency and desired aroma). Extended drying just after harvest (and usually at assemblers and wholesalers level) is another problem. This has also serious impact on the color and nutritional content of the commodity.

Adulteration: As there is no standardized and tolerable threshold level for the presence of foreign material, adulteration is a major challenge in hot pepper marketing (especially for ground form of the product).

4. Conclusion and Recommendations

In order to intensify the emerging commercialization in the district, markets should be efficient, hot pepper trading need to be diversified, and market imperfections should be minimized. The result indicated that the commodity was in the hands of few traders depicting absences of competition. The concentration measure showed that the highest share (67.41) was taken by wholesalers in Addis Ababa. Marketing margins calculated for each marketing actors were found to be wide, which is the result of low producer prices and relatively high consumer prices (strategically set by terminal market wholesalers. The oligopolistic nature of the commodity market had created convenient situations for the traders to set the price excluding producers and consumers who ultimately become price takers. In addition, price fluctuations, inadequate price information, and weak bargaining power of producers were among the major problems.

As an emerging enterprise, Jabi Tehinan district is one of the main supply sources of pepper to the terminal market. The study indicated that of the total of 39,544qts of pepper produced, the amount that was transacted along the market channel was 7,513qts. There should be special concern to the production problems like pests, diseases, and input usage.

In order to improve the problem of pepper price fluctuation and the bargaining power of producers, implementation of a well-defined standard of the commodity is relevant. Concerned bodies should practice product grading and price differentiation based on the quality of the pepper such as color, pungency, and pod size. Hence, for a defined standard of the commodity, a common price can be set.

The result revealed that pepper is concentrated in the hands of few traders and the margin share difference among actors is very large. In order to improve the consumer price spread among different marketing actors, the market structure, competitiveness, and the participation level of others who want to join pepper trading, and training about pepper trading should be given to interested actors. Since pepper trading requires high capital, facilitating credit services to traders (existing and emerging) may attract new traders to involve in the business.

Gross marketing margins were lowest for farmer traders who do not have a better access to day-to-day price information. This implies that establishing an information network among the marketing actors can help improve the market efficiency.

In order to address the marketing problems and opportunities of hot pepper in the study area, additional research should be undertaken and thus the findings of this study should not be used as generalizations to the neighboring pepper growing zones as they have different biophysical and socio-economic set up.

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8. Value Chain Analysis of Maize: The Case of Nedjo Woreda, Oromia National Regional State

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Abstract

The purpose of this study was to analyze maize marketing costs and margins of different actors along the value chain, and to identify factors affecting marketed surplus of maize at producers' level. The result of marketing costs and margins shows that farmer traders incurred the smallest marketing costs followed by retailers. Of all maize traders, retailers get the highest gross marketing margin. The probit model analysis revealed that livestock holding, number of oxen, farm size, extension service, use of recommended technology package, and non/off-farm activities have significantly affected the probability of household's market participation. Similarly, the second stage Heckman model indicated that recommended technology package, access to irrigation, number of oxen owned, livestock holding, and education level of the household head have significantly affected the volume of maize sold. The findings of the study underscore the need to focus on these significant variables while designing policy interventions.

Keywords: Maize; value chain; Heckman two-stage model; market participation

1. Introduction

Agriculture plays an important role in the development of many countries. It is a primary source of income, food, and sustenance for the world's populations. In most developing countries, even though it is still at the subsistence level, it is a major employer of labor particularly in rural areas. In the advanced nations, the mechanization of agriculture, high level of technology, modern storage facilities, availability of expansive farmlands as well as credit facilities have contributed immensely to the quality and quantity of food produced.

A 'value chain' in agriculture identifies the set of actors and activities that bring a basic agricultural product from production in the field to final consumption, where at each stage value is added to the product. A value chain can be a vertical linking or a network between various independent business organizations and can involve processing, packaging, storage, transport, and distribution. Value-added agriculture has attracted considerable attention in recent years as a means to increase and/or stabilize farm incomes and to rejuvenate primary agriculture and the rural economy. The move to value-added agriculture is fundamentally market-driven. Value-added activities are born from the necessity to adapt to the wide-ranging changes affecting the agriculture and agro-food industry. These changes stem from many interacting factors: the quick expansion of agricultural trade and the resulting concentration in the agro-food industry, an increasingly segmented consumer base, shifting consumer preferences, changing

demographics and income profiles, innovation in food and non-food uses of agricultural products and trade related issues, including border closures, in an increasingly integrated global market (AAFC, 2004).

Increased competition as a result of globalization has resulted in lower returns for actors in African agriculture, including farmers and agro-processors, as they have continued to lag behind their competitors in innovation and the ability to set their products apart. With globalization, product distinction and branding are becoming increasingly important ingredients for market differentiation and upgrading strategies. This is especially due to greater consumer awareness, with demand for superior and differentiated products (FAO, 2003).

Ethiopia produces many cereal crops like *teff*, maize, sorghum, millet, wheat, barley, rice, and oat that are used as a source of food grain, feed /for livestock/, fuel, medicine and alcohol in the country. Maize ranks first among cereals followed by *teff*, wheat, and sorghum with contributions of 17.57%, 15.65%, and 16.05% in the total grain production, respectively (CSA, 2015).

Maize is the common product produced in Nedjo woreda of Oromia for many purposes. Total land area of about 5565 hectares are covered by maize in the woreda and its productivity was 55.9 quintals per ha, from which a total volume of about 31110.6 tons of maize are obtained. Maize is the crop commonly used for consumption in rural and urban communities. It is consumed as *injera* and other different forms of food items and for preparing local drinks. However, the smallholders may face many problems regarding input supply, production and marketing activities of maize products. To exploit the opportunity of the current growing demand for maize products, development programs and approaches, which bring all maize actors together, are fundamental to improve quality and strengthen linkages. Therefore, this study initiated for the purpose of analyzing marketing costs and margins of different market actors, and identifying factors affecting market participation and marketed surplus at the producer's level in the study area.

2. Research Methodology

2.1. Description of the Study Area

Nedjo Woreda is one of the administrative divisions under West Wollega Zone of Oromia National Regional State. Agriculture is the main source of food and income for the population in the woreda. The Woreda enjoys mean annual rainfall of precipitation ranging from 700 - 900 mm. The rain season extends from mid-April to mid-September with highest rainfall usually recorded in August. The woreda is found in *Woina-Dega* climatic zone with the mean annual temperature ranging between 23-25^{o}c and its total surface area is 95,800 hectares among which 75,312 hectares are cultivated land. The woreda is located at 1600 to 1900 meter above sea level. (DLAECO, 2007).

Agricultural in the area is characterized by less diversity, low productivity, low use of agricultural technologies, weak linkage with agricultural research and extension services, lack of adequate marketing and other market infrastructure facilities. The study area is characterized by a farming system consisting of crops like maize, sorghum, finger millet, *teff*, nug, wheat, barley, vegetables, and fruits. Coffee is the main cash crop in the study area in which around 845 hectare of land is allocated for its production and its productivity is 6.46 tons/hectare (DARDO, 2007).

2.2. Data and Sampling Technique

Both qualitative and quantitative data obtained from primary and secondary sources have been used for the study. Structured questionnaires and personal interviews were used to collect the data. Primary data were collected from different value chain actors at different levels. Maize producing farm households, cooperatives, and traders (farmer traders, retailers, and wholesalers) were surveyed. For the primary data collection, a two stage sampling technique has been used to draw the sample maize-producing households. First, in consultation with agriculture and rural development office of the district, kebeles were stratified into a high potential and low potential kebeles. Accordingly, 36 kebeles were high potential and the remaining 13 kebeles were low potential (DARDO, 2007). Then, three kebeles from the potential ones and one kebele from the less potential ones were randomly and proportionally selected.

Finally, the required sample size was selected according to the sampling formula provided by Cochran (1963). Accordingly, 119 sample farmers were randomly selected on the basis of proportion of households in the selected kebele using 95% confidence level with degree of variability of 0.5 and level of precision equal to 9%, which is recommended to obtain a sample size required to represent the population.

$$n_o = \frac{z^2 pq}{e^2} \quad (1)$$

Where n_0 is the sample size, Z^2 is the abscissa of the normal curve that cuts off an area α at the tails ($1 - \alpha$ equals the desired confidence level, e.g., 95%) or standard normal deviation (1.96 for 95% confidence level), e is the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and q is 1-p.

From the available wholesalers in the woreda, 50% were selected. In addition, other market traders (retailers and farmer traders) who were available in the market where selected purposively. This is because the total population list of these actors (retailers, farmer traders and consumers) was not available. Accordingly, three wholesale traders, five farmer traders, ten retailers, and thirty consumers were purposively selected.

2.3. Methods of Data Analysis

Both descriptive and econometric analysis were employed to analyze the data.

2.3.1. Marketing margin analysis

A marketing margin may be defined alternatively as a difference between the price paid by consumers and that obtained by producers or; the price of a collection of marketing services that is, the outcome of the demand for and the supply of each service (Tomek and Robinson, 1990). It can be used to show how the consumers' money will be divided among participants at different levels of the marketing system.

Computing the total gross marketing margin (TGMM) is always related to the final price paid by the end buyer and is expressed as a percentage (Mendoza, 1991).

$$TGMM = \frac{End\ buyer\ price - First\ seller\ price}{End\ buyer\ price} x100 \quad (2)$$

Where TGMM is total gross marketing margin.

It is useful to introduce the idea of 'producer's participation', 'farmer's portion', or 'producer's gross margin (GMM_P) which is the portion of the price paid by the consumer that goes to the producer. Production and marketing costs are frequently difficult to

determine in many agricultural value chains for the reasons that costs are often cash and imputed, the gross and not the net marketing margin is calculated. The producer's margin is calculated as a difference among end buyer price and marketing gross margin.

$$GMM_P = \frac{End\ buyer\ price - gross\ marketing\ margin}{End\ buyer\ price} x\ 100 \quad (3)$$

Where GMMp is the producer's share of consumer price or gross marketing margin of producers.

2.3.2. Econometric analysis

For this study, two dependent variables; market participation decisions expressed as dichotomous variable and marketed surplus of maize expressed as continuous variable, are considered. Ideally, the OLS is applicable to determine factors that affect the level of participation. However, some households may prefer not to participate in a particular market in favor of others, whereas others may be excluded because of market conditions or households resource constraints. If OLS regression is estimated while excluding the non-participating from analysis, a sample selectivity bias is introduced into the model.

The Tobit model is also applicable for censored data, i.e. it is applicable to determine factors that affect market participation decision and volume sold. However, households' participation into output market which is the intensity of market participation may give rise to too many zeros. In the Tobit model, all households including those censored zero values are included without considering the source of the zeros. This is by ignoring all the zeros by assuming that all zeros that arise by non-participation decision of households could be due to socioeconomic, demographic, institutional, information access, and other related factors (Newman *et al*., 2003). However, these may not be the case.

As a result, the Heckman's two-stage selectivity model was used in this study where the Inverse Mill's ratio calculated from probit estimation in the first stage is used as an independent variable in the second-stage OLS model.

The first step of Heckman procedure establishes the probability of participation in the output market. For the individual producer, the decision to participate or not to participate in maize marketing was formulated as binary choice model that was analyzed using the probit equation below:

$$BMP_i^* = X_i \beta + \varepsilon_i \quad (4)$$

$BMP_i = 1$ If $BMP_i^* > 0$

$BMP_i = 0$ If $BMP_i^* < 0$

Where, X_i is a vector of explanatory variables; β is a vector of parameters to be estimated; BMP_i^* is the estimated market participation probability; and ε_i is a random error term for the selection equation.

The second stage of heckman's two stage procedure for this study was an OLS specified as:

$$BMS_j = \beta_0 + \beta_{1j}X_{1j} + \beta_{2j}X_{2j} + \beta_{3j}X_{3j}.....+ \beta_{nj\ Xnj} + \varrho_{nj}\lambda_{nj}\ (X_{nj}\beta)_j + \varepsilon_j \quad (5)$$

Where BMS_j is volume of marketed surplus by the jth producer in quintal; X_{1j} up to X_{nj} are exogenous variables in the second stage; β_js are parameters to be estimated; $\lambda_{nj}(X_{nj}\beta)_j$ is the Inverse Mill's ratio derived from the first stage; and ε_j is the error term in the second stage.

3. Results and Discussion

3.1. Descriptive Results

According to the survey result, the average family size of the total sample households in adult equivalent was 6.7 persons, with 3 and 12 being the minimum and the maximum household sizes, respectively. About 74.8% of the sample households are headed by male and the rest 25.2% are headed by female. In the study area, 70.6% of the sample household heads are found to be literate whereas 29.4% of the sample household heads are found to be illiterate. The mean livestock holding in Tropical Livestock Unit (TLU) for the sample households is 6.6 without oxen, where the minimum and maximum are 0.04 and 14.2, respectively. The mean number of oxen for the sample households is 2 oxen or a pair of oxen.

The study result showed that the average labor force available per sample household was 4.7 man-days. About 48.7% of the respondents had access to irrigation for maize production and about 24% of respondents have reported that they got involved in various non/off-farm activities during production season. The result also showed that 68.1% of the sample households got access to extension service.

From the sample households, 60.5% did not take credit due to various reasons like restrictive procedures, high interest rate, no credit available, and inadequate repayment schedule. The survey result indicated that about 84% of the sample farmers used full-recommended technology packages like row planting, improved seed, fertilizers and pesticides. The mean farm size owned by households is 1.4 hectare, where the minimum is 0.25 and the maximum is 3 hectares. Results of the other variables are as indicated in Tables 1 and 2.

Table 1. Descriptive results for dummy variables.

Variables	Participants in the market (%)	Participants in the market (%)	$\chi 2$ value
Sex	26.39	23.40	0.714
Female			
Male	73.61	76.60	
Educ. Status:	68.10	74.47	0.453
Literate			
Illiterate	31.90	25.53	
Credit access:	40.28	38.30	0.829
Yes			
No	59.72	61.70	
Access to extension:	77.78	53.19	0.005***
Yes			
No	22.22	46.81	
Use of technology:	98.61	61.70	0.000***
Yes			
No	1.39	38.30	
Access to irrigation:	59.72	31.90	0.003***
Yes			
No	40.28	68.10	
Invol. in non/off-farm:	8.33	48.94	0.000***
Yes			
No	91.67	51.06	

Source: Authors computation (2015).

Table 2. Descriptive results for continuous variables.

Variables	participants		Non-participants		Total		t-value
	Mean	SD	Mean	SD	Mean	SD	
Household size	6.89	1.65	6.34	1.87	6.67	1.75	-1.6822
Livestock (TLU)	6.37	1.61	6.83	3.18	6.55	2.38	1.003
Oxen (no.)	2.49	1.02	1.45	0.80	2.08	1.07	-5.878
Labor (no.)	4.99	1.74	4.35	1.89	4.74	1.82	-1.775
Farm size (ha)	1.72	0.73	0.97	0.60	1.42	0.78	-5.908

Source: Survey result (2015).

3.2. Marketing Costs and Margins

The important points to be considered in value chain analysis are marketing costs (cost for value added on the product at different levels by market actors along channels), margin, number of intermediaries and share of producers as well as intermediaries from consumers' price. In order to investigate the shares and margins of several market agents, who are involved in maize value chain, different channels starting from farm gates to consumer price are considered. Price per quintal for maize was used for the marketing margin calculations. Results of analysis of marketing costs and margins were used to determine whether there were excess profits and serious inefficiencies or whether wide margins are due to technical constraints (such as transportation bottlenecks). Margin and cost calculation were carried only for key maize marketing channels.

As a result, before computing marketing costs and margins of maize traders in maize value chain, it is important to discuss the existing key maize marketing channels in the study area. The analysis of marketing channels is intended to provide a systematic knowledge of the flow of goods and services from their origin (producer) to the final destination (consumer). There were maize marketing channels in which the product (maize) reached in the hands of consumers as it is depicted below. The result revealed that there are five (5) major marketing channels. The actual marketing channel is more complicated, but the main marketing channels of maize markets in terms of maize flow from producer to consumer through different intermediaries are:

Channel I. Producers → consumers
Channel II. Producers → farmer traders → retailers → consumers
Channel III. Producers → retailers → consumers
Channel IV. Producers → wholesalers → retailers → consumers
Channel V. Producers → farmer traders → consumers

Following the above maize marketing channels, Table 3 and Table 4 indicate an overview of marketing costs and margins among different marketing actors in different channels. The result of marketing costs and margins indicates that farmer traders incurred the smallest marketing costs followed by retailers. The wholesalers bear the highest cost, which was Birr 25.50 per quintal. Table 2 revealed that the total gross marketing margin (TGMM) is highest in Channel II, which accounts for 19.2% of the consumer's price. Of all maize traders, retailers get the highest gross marketing margin in channels II, III, and IV, which are accounted for 9.6% of consumer's price, respectively. In general, producer's share in consumer price is greater than 50% in all channels.

Table 3. Marketing costs of different marketing actors in maize value chain.

Marketing costs	Market traders		
	Farmer traders	Retailers	Wholesalers
Transport/quintal	10.00	7.00	8.00
Load/quintal		6.00	7.00
sales tax/quintal		1.50	3.00
Storage/quintal	1.00	1.00	
Cleaning/quintal			7.50
Total marketing costs/quintal	11.00	15.50	25.50

Table 4. Marketing margins of different marketing actors in maize value chain.

Marketing margin	Marketing channels				
	I	II	III	IV	V
Average Consumer price/quintal	360	416	416	416	368
Average Producer price/Qt	360	336	376	347	336
TGMM (%)	0.00	19.23	9.62	16.59	8.70
GMMp (%)	100.00	95.38	97.69	96.01	97.64
GMMft (%)		7.69			8.70
GMMr (%)		9.62	9.62	9.62	
GMMw (%)				9.38	

Source: Survey result (2015).

3.3. Econometric Results

Results of the probit and OLS models are summarized in Table 5. In the first stage, households decide whether they will be sellers, or not. The decision to participate in the maize market was estimated by probit maximum likelihood estimation method. The results of second-stage Heckman selection estimation indicates the decision on the amount of maize supplied to the market. These decisions have been assessed using a Heckman selection model. Use of recommended technology package, access to irrigation, oxen owned, livestock holding, education status, and Inverse Mill's Ratio (LAMBDA), had significant impact on quantity of maize supplied. The significant variables are described as follows:

Livestock holding: As expected, livestock holding is negatively related with the farmer's participation decision in the maize market and it is statistically significant at 5% significance level. That is a unit increase in livestock leads to a decrease in the probability to participate in maize market by 2.9%. In addition, livestock holding influenced the quantity of maize supplied to the market negatively and it is statistically significant at less than 1% significance level. The study result shows that a unit increase in the livestock causes 0.45 quintals decrease for quantity of maize marketed. This is because of the fact that land is scarce to hold more livestock as grazing land will in turn be low to support more livestock. The societies consider livestock holding as a prestige or wealth status. Consequently, if they decided to produce more livestock, they have to divert from producing crop (maize) to livestock production to overcome lack of grazing land. This study is against the findings of Astewel (2010) where livestock holding raised the probability of market participation in rice market. The findings of Rehima (2006) on analysis of red pepper marketing suggested that number of livestock holding negatively

affected quantity of pepper sold. However, the findings of Haymanot (2014) indicated that tropical livestock unit was found to influence volume of durum wheat marketed positively, against the results of this study.

Number of oxen owned: As hypothesized, number of oxen owned by household head influenced the farmers' decision to participate in maize market positively and it is statistically significant at less than 1% significance level. The result shows that a unit increase in a number of oxen increases the participation decision of the households in maize market by 10.3%, keeping other factors constant. This is mainly because maize lands are relatively large as compared to that of other croplands in the area and thus producers require oxen power to cultivate maize. The study conducted by Abay (2007) on vegetable market chain analysis found that there is direct relationship among number of oxen owned by households and onion market participation decision. However, the findings of this study is against the result of a study by Amare (2014) which shows that the number of oxen possessed by households significantly and negatively affected the market participation decision of households.

Additionally, as hypothesized, oxen owned by the household heads influenced the sales volume of maize positively and it is statistically significant at less than 1% significance level. The result shows that a unit increase in a number of oxen increases the quantity of maize marketed by 1.1 quintals. This is because as oxen are the main sources of traction power for the farmers, the number of oxen owned increases the quantity of maize marketed. The findings of Kindie (2007) on sesame market chain analysis showed that number of oxen owned was found to affect sesame marketed surplus positively which is in line with the findings of this study.

Farm size: As expected, this variable had a positive sign and significant at less than 5% significance level. This indicates that the larger the land size that households allocate for maize production, the more likely that the households participate in the maize market. The regression coefficient showed that as farm size increases by one hectare, the market participation decision of the households increase by 12.3%, keeping the influences of other factors constant. This result is in line with the result by Tigist (2015) which indicated land holding positively and significantly affecting smallholders' market participation.

Access to extension contact: Frequency of extension contact affected participation decision of framers in maize market positively and significantly at less than 5% significance level which is in line with the findings of Abay (2007). On average, if a maize producer gets extension contact frequently, the decision to participate in maize market increases by 14.4%, keeping other factors constant. This suggests that access to extension service avails information regarding technology in turn improving production that affected market participation decision of households. Additionally, the findings of this study is supported by the findings of Astewel (2010) which showed that extension contact with farmers has positive influence in the rice market participation decision.

Use of recommended technology package: Using improved agricultural technologies are important to provide high yield of crops. According to Mesfin *et al.* (2004), using improved technologies such as improved seed, fertilizers, and herbicides leads to an increase in the teff productivity. This may in turn leads to an increase in the market participation decision of farmers. As hypothesized, use of recommended technology package is directly related to the decision of farmers to participate in maize market and it is significant at less than 1%. On average, if maize producers use recommended

technology packages, the decision of households to participate in maize market increases by 27%.

In addition, use of recommended technology packages is directly related with sales volume of maize and it is statistically significant at less than 1% significance level. On average, if maize producers use recommended technology package, the quantity supplied of maize to the market increases by 3.6 quintals, keeping other variables constant. According to the study conducted by Kindie (2007)**,** use of improved agricultural inputs was found to influence marketed surplus of sesame positively.

Participation in non/off-farm activity: As expected, participation in non/off-farm activity had inverse relation with the decision of farmers to participate in maize market and it is significant at less than 1% significance level. The result shows that participation in non/off-farm activity leads to a decrease in the maize market participation of households by 33.8%, against the positive relationship depicted by Amare (2014). This may be explained by the fact that farmers participated in non/off-farm activity will not tend to generate cash from sell of agricultural commodities (maize) as they are generating income from non/off-farm activity.

Education status of household head: Education level of household heads affected marketed surplus of maize positively and significant at less than 10% significance level. On average, if maize producers are educated, the amount of maize supplied to the market increases by 0.67 quintals. The finding of this study is in consensus with a finding by Amare (2014) where education level positively affected pepper market participation decision of households. This is because of the fact that producers who have higher level of education have better attitudes towards the use of new technologies and input utilization. Furthermore, education increases farmers' ability to get, process, and use information.

Access to irrigation: As expected, access to irrigation is related with sales volume of maize positively in the study area and it is statistically significant at less than 1% significance level. The result indicated that access to irrigation leads to an increase in the amount of maize that households supply to market by 1.3 quintals. This is in line with a study by Pingali *et al.* (2008). This is because farmers with access to irrigation produce more may be though two-season production which is not possible under rain-fed situation. Due to the result of this increasing productivity, farmers' willingness to supply maize in the market increases.

Inverse Mill's Ratio (LAMBDA): The inverse Mill's ratio affected the quantity supplied positively at less than 5% significance level and it indicates that in Heckman two-stage model, the correction for selectivity bias is significant. The significance of Lambda indicates the existence of interdependence between the selection equation (participation decision equation) and sales volume of maize in the study area. This mean that there were unobserved factors that determine maize market participation decision equation as well as volume supplied (outcome) equation to the market.

Table 5. Results of the Heckman selection model

Variables	Participation model (probit)		Marketed surplus model (OLS)
	Coefficients (SE)	Marginal effects (SE)	Coefficients (SE)
Constant	-2.919 (1.067)	---	-1.107 (2.055)
Livestock holding	-0.192 (0.089)	-0.029** (0.013)	-0.478*** (0.109)
Oxen ownership	0.674 (0.247)	0.103*** (0.032)	1.096*** (0.197)
Access to irrigation	0.383 (0.392)	0.059 (0.059)	1.254*** (0.355)
Education status	0.024 (0.418)	0.004 (0.064)	0.669* (0.356)
Labor availability	-0.015 (0.107)	-0.002 (0.016)	0.001 (0.094)
Extension contact	0.940 (0.424)	0.144** (0.061)	0.069 (0.414)
Distance to the market	0.025 (0.023)	0.004 (0.003)	-0.011 (0.015)
Sex	-0.062 (0.447)	-0.009 (0.068)	0.107 (0.397)
Farm size	0.386 (0.284)	0.123** (0.050)	0.229 (0.281)
Access to credit	0.465 (0.412)	0.071 (0.062)	0.013 (0.354)
Access to technology	1.765 (0.564)	0.270*** (0.073)	3.641*** (1.367)
Access to non/off-farming activity	-2.211 (0.616)	-0.338*** (0.073)	-
Inverse mill's ratio			1.369** (0.671)
Number of obs (0.0000***)	= 119	Wald chi2 (11)	= 99.76
Censored obs	= 47	rho	= 1.00000
Uncensored obs	= 72	sigma	= 1.3689795

*Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10%, respectively.*

4. Conclusion and Recommendations

The results of marketing cost and margin indicates that farmer traders incurred the smallest marketing cost followed by retailers. Of all maize traders, retailers get the highest gross marketing margin whereas farmer traders obtained the lowest gross marketing margin.

The maximum likelihood probit model analysis revealed that livestock holding, number of oxen owned by household, access to irrigation, extension service, recommended technology package and access to non/off-farm activity were found to exert significant impact on probability of the households to participate in maize market. However, the second stage (OLS estimation model) of the Heckman two-stage procedures identified recommended technology package, access to irrigation, number of oxen owned, livestock holding, education status of the household, and inverse mill's ratio as important factors affecting sale volume of maize.

It is pertinent to suggest non-participant farmers to properly allocate their land between crop production and livestock production, and properly allocate their family labor between farm and non/off-farm activities. Efforts aiming at expansion of maize production should consider the means to enable farmers to get access to farm power through renting mechanisms and provision of credit service for the purchase of oxen. Policy efforts should also give due attention to enhance the use of recommended technology packages for establishment of modern irrigation system and proper management techniques. Furthermore, concerted effort should be made to update the

theoretical and practical knowledge of the extension personnel through in service training. Development programs to promote and encourage agricultural production in general and maize production in particular should focus on the establishment of skill training centers at local levels.

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9. Value Chains and Market Supply of Certified Coffee in Dale District of Southern Ethiopia

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Abstract

The objective of this study was to analyze value chain of certified coffee and to identify determinants of smallholder farmers' intensity of participation in the chain. The study used both qualitative and quantitative data collected through household survey using structured questionnaire from 155 sample smallholder coffee farmers in five double certified (Fairtrade and Organic) coffee farmers' cooperatives and conducting FGD and KII with value chain actors, supporters and influencers and reviewing secondary sources. Truncated regression model was employed to identify factors determining smallholder farmers' intensity of participation. Accordingly, sex, proportion of land allocated for coffee, trust in cooperative management, annual coffee production & agricultural cash income influenced the dependent variable positively, while age, education level, and distance from the cooperative office have a negative influence. On the other hand, the value chain analysis identified key value chain actors, supporters, and influencers with their respective roles, and associated constraints and opportunities. The existing governance structure was also highlighted to create a better understanding of the existing power relationship.

Keywords: Coffee certification; smallholder farmers; cooperatives; value chain analysis; Ethiopia

1. Introduction

Coffee has a great social, cultural and livelihood importance for the majority of Ethiopian population and to the national economy. The country produces more than 30% of the total coffee production in Sub-Saharan Africa and it also consumes nearly 50% of the total production blended with complex socio-cultural settings. In 2012/13 fiscal year it generated 24.2% of the total export revenue (NBE, 2014). Moreover, about 25 % of the total population is dependent on production, processing, distribution and export of coffee (Mekonen, 2009).

Due to these reasons, the coffee sub-sector has enjoyed higher attention under the current agricultural commercialization strategy. The production of high value crops like coffee is one of the distinctive features of the new strategic direction being pursued by the government of Ethiopia and many development partners. This is part of the multi-faceted efforts geared towards transforming the country's age-old subsistence agricultural farming system into commercial oriented and export led production (MoFED, 2010).

Though several efforts have been exerted to exploit the most possible reward from the coffee production and export, still several complex challenges are observed cracking the

road to higher benefit share. Among the key challenges facing the whole coffee sub-sector in Ethiopia, the volatile nature of global coffee price is critical one. This has been a real source of vulnerability for smallholder producers. Countries like Ethiopia have a very low market share, often below 5% in the international coffee trade. Due to this, Ethiopian smallholder coffee farmers receive only a fraction of the retail price and continued to engage in subsistence farming.

In the history of the international coffee market, the period between 1990 and 2004 had been referred commonly as "The coffee price crisis" which had passed shading enormous economic and social impacts on smallholder coffee growers around the globe (Mendez *et al.*, 2010). In an effort to identify ways out of the periodic crisis and to confront the coffee price crisis, various 'sustainable coffee' certification initiatives have emerged as key alternative options for smallholder coffee farmers (Wollni & Zeller, 2007; Mendez *et al.*, 2010). Following this, due to the increasing poverty and vulnerability of smallholder coffee farmers in major coffee producer countries and growing demands for healthier and more socially and environmentally-friendly coffee, coffee certification of cooperatives has gradually gained wider recognition and significance worldwide (Petit, 2007; Stellmacher & Grote, 2011; Jena *et al.*, 2012).

In Ethiopia, several initiatives led by various stakeholders involving the government, NGOs and multi-lateral development organizations have been working extensively in supporting coffee farmers' cooperatives certifications and enhancing the whole coffee value chain. As a result, over a period of a decade or so, many coffee farmers' cooperatives have been certified to different certification schemes, including Fairtrade, Organic, and Utz Kapeh. Moreover, the Ethiopian Government made institutional reforms which enhance smallholders' participation in the international coffee value chain.

Despite such initiatives and regardless of its presumed importance, the level of participation of smallholder farmers in such value chains has not been as expected and varies among farmers. Previous coffee value chain analyses have mainly focused on the conventional coffee value chain and gave relatively less space for the certified channel. Moreover, there is lack of empirical local studies and evidence in the topic. Thus, this study attempts to analyze certified coffee value chain in the study area and further investigates determinants of smallholder farmers' intensity of participation in the value chain.

2. Methodology

2.2. Description of the Study Area

Dale District is located in Sidama Zone, SNNPR, at 320 km south of Addis Ababa and 50 km from the regional capital, Hawassa. The total population of the District as of 2012 was 237,106. The District is one of the most densely populated areas in the region, with population density of around 856 person/km^2. The average annual rainfall is 1200 mm, ranging between 801 to 1600mm. The altitude in the physical areas across the District ranges between 1501 to 2500m.a.s.l (BoFED, 2012).

Currently there are eight coffee farmers' cooperatives in the study area, having a total member size of more than twenty one thousand. Out of these, five are Organic and Fairtrade certified while three are Fairtrade certified.

In Sidama Zone, 51 coffee farmers' cooperatives operate under the umbrella of the Sidama Coffee Farmers' Cooperative Union (SCFCU). These cooperatives have over 87,000 member farmers and this makes the Union the second largest coffee producing cooperative union in Ethiopia. The cooperatives are all established in the late 1990s and early 2000. Since 2003, the Union has been aggressively supporting its cooperatives to

get Fairtrade, Organic, Utz Kapeh, and Rainforest Alliance certifications. Fairtrade and Organic certifications are the top priority schemes perused so far. Currently 41 of its member coffee cooperatives are Fairtrade certified, 39 are Organic certified, 5 with Rainforest Alliance and 2 with Utz Kepeh. Double certifications of Fairtrade and Organic are common and the number of triple certified cooperatives is also growing slowly.

2.2. Data and Sampling Procedure

The study used both qualitative and quantitative data from primary and secondary data sources. Primary data was collected using structured questionnaire, semi structured interview, two focus group discussions (FGD) with smallholder coffee farmers from two certified coffee farmers' cooperatives (CFCoops), and key informant interviews with representatives of actors in the value chain including Coffee cooperatives, SCFCU, extension service providers (District Agriculture and Natural Resource Development Office and Cooperative & Marketing Development Office), NGO - TechnoServe, and certification and quality inspection company called CERES. Secondary data was also collected from various sources including Sidama Coffee Cooperatives Union, Coffee cooperatives and other governmental and non-governmental organizations, different studies and official web sites.

A two-stage sampling technique was used in this study. In the first stage, out of the eight coffee farmers' cooperatives in Dale District, five double certified (organic and Fairtrade) coffee farmers' cooperatives were selected purposively - to have a similar group of smallholder coffee farmer that have the same level of certification opportunity. Then, a total sample size of 155 smallholder farmers were determined using the simplified formula provided by Slovin (1960) cited by Adanza (1995) as given below.

$$n = \frac{N}{1+N(e)^2} \quad (1)$$

Where, n = sample size, N = population size, e = level of precision. The level of precision is the range in which the true value of the population is estimated to be; it is expressed in percentage points, and 8% level of precision is considered for this study.

The respective sample unit from each cooperative was determined using probability proportional to size sampling technique (Table 1). Finally, individual sample smallholder farmers were selected by using systematic random sampling technique.

Table 6. Distribution of sample coffee farmers across sample cooperatives.

Name of Selected Coops	Member Size			Number of smallholder farmers sampled (n)
	Male	Female	Total	
Shoye	4332	127	4459	46
Boa Bedegelo	3159	183	3342	34
Waycho	1825	87	1912	20
Wicho	3321	136	3457	35
Goyida	1803	116	1919	20
Total	14,440	649	15089	155

Source: Author's compilation based on data from Dale District Marketing and Cooperatives Development Office and SCFCU (2014).

2.3. Methods of Data Analysis

Value chain analysis

The study adopted the Global Value chain analysis methodology developed by Gerefi and Fernandez, 2011, as a guiding analytical framework. Global value chain methodology explores four basic dimensions: "(1) an input-output structure, which describes the process of transforming raw materials into final products; (2) an institutional context in which the industry value chain is embedded; (3) a governance structure, which explains how the value chain is controlled; and (4) a geographical consideration" (Gereffi and Fernandez, 2011). Based on the objectives and scope of the study, the analysis focused on the first three dimensions. Value chain mapping and SWOT analysis were also conducted to substantiate the analysis.

In this study, descriptive statistics was used for the purpose of discussion and comparison of some important variables in the sample. The descriptive analysis was made using mean, standard deviation, minimum as well as maximum values. In addition, chi-square and t-tests were employed to compare participants in certified coffee value chain with respect to the explanatory variables.

Analysis of market participation

Econometrics model (truncated regression) was used to identify and analyze socioeconomic and institutional factors, which affect the intensity of participation of smallholder farmers in certified coffee value chain. Inferring the characteristic of a population from a sample drawn from a restricted part of the population is done in two ways based on the type of truncation; i.e. incidental truncation and truncation by survey design (Greene, 2003).

Truncation due to survey design, which is the case at hand in this study, happens when a sample is drawn from a certain restricted sub population as determined by the surveyor's decision. This type of truncation happens because the surveyor samples people based on the value of y-variable (smallholder farmers who are supplying coffee through certified coffee value chain are sampled for the study).

A sample from such truncated population cannot be used to make inferences about the entire population without correction for the fact that those included individuals are not randomly selected from the population at large. While it might appear that we could use these truncated data to make inferences about the subpopulation, we cannot even do that. A regression estimated from the sub-population will yield coefficients that are biased toward zero or attenuated as well as an estimate of σ_u^2 that is biased downward. Consider the following regression which satisfies all the OLS assumptions.

$$y^*_{i = x_i'\beta+\varepsilon_i} \qquad \text{with } \varepsilon_i \sim N(0, \sigma^2) \tag{2}$$

The distribution of y_i^* given x_i is therefore also normal: $y_i^*|x_i \sim N(x_i'\beta, \sigma^2)$

The expected value of the latent variable is

$$Ey_i^* = x_i'\beta \tag{3}$$

Observation i is only observed if y_i^* is above a certain known threshold *a* i.e.,

$$y_i = \begin{cases} y_i^* \; if \; y_i^* > a \\ n.a. if \; y_i^* \leq a \end{cases} \tag{4}$$

As can be seen, running OLS on the truncated data will cause biases. The model that produces unbiased estimates is based on the Maximum Likelihood Estimation. For each observation, we can write $\varepsilon_i = x_i'\beta - y_i$. Thus, the likelihood contribution is the height of the density function. However, since we select sample only if $y_i^* > a$, we have to use the density function of ε conditional on $y_i^* > a$.

2.3. Definition of Variables and Working Hypothesis

Based on literature review conducted 16 explanatory variables were hypothesized to influence smallholder farmers' intensity of participation in certified coffee. List of variables explain the dependent variable with brief definition and working hypothesis is indicated in Table 2. The dependent variable is the quantity of red cherry coffee supplied though certified coffee value chain in kilograms.

Table 7: Summary of definition of variables and working hypothesis.

Definition of variables	Measurement	Expected effect
Age of the household head, number of years	Continuous	+-
Sex of the household head, 1 if male 0 female	Dummy	+
Number of formal schooling grade the farmer completed	Counts	+
Number of people living in the same roof	Continuous	+/-
Coffee farming experience	Continuous	+
Proportion of land allocated for coffee, ratio	Continuous	+
Annual coffee production, Kg	Continuous	+
Annual agricultural cash income, Birr	Continuous	+
Access to coffee market information, 1 if yes, 0 otherwise	Dummy	+
Utilization of credit for coffee production and marketing, 1 if yes, 0 otherwise	Dummy	+
Number of extension visit the farmer had within 12 months regarding coffee production and/or marketing, Frequency	Continuous	+
Number of years the farmers spent as a member of a Coop	Continuous	+
The distance between the farmer's house and the local coffee spot market, Km	Continuous	-
Farmer's perception on the benefit of participation in certified coffee value chain, 1 if beneficial , 0 otherwise	Dummy	+
Farmer's degree of agreement to the statement: "the members of our cooperative are committed to the bylaws and delivery obligation of the cooperative", 5-point Likert scale	Categorical	+
Summated Multi-item Likert scale	Continuous	+

3. Results and Discussion

3.1. Value Chain Analysis

The findings of the certified coffee value chain analysis are organized in the following three sub sections.

Value chain actors, supporters and influencers/context

Value chain actors, supporters and influencers in certified coffee are described below with their respective key roles and the relationship among each other. Looking at these three entities is considered as a comprehensive approach to look at the three levels of the model i.e. micro, meso and macro levels (KIT and IIRR, 2010).

i. Value chain actors

Value chain actors are directly involved in the transformation of the product from input all the way through the final delivery to consumers. These include input suppliers, smallholder coffee farmers, coffee farmers cooperatives, Sidama Coffee Farmer Cooperatives Union, and international certified coffee buyers (coffee importers, roaster, retailers). However, due to the scope and limitation of this study, the discussion here is restricted to the four upstream chain actors. It covers all the value addition activities from input supply to exporting of green coffee to international certified coffee buyers. The table below summarizes these activities synthesized with the existing opportunities and constraints at each stage.

ii. Value chain supporters

As the name clearly tells, value chain supporters are like second level players in the value chain next to the main chain actors. They provide different support services including financial services as well as a wide array of non-financial services such as transport, grading, processing, storage, advertising, research, training, advice, organizational strengthening, and so on (KIT & IIRR, 2010). In the certified coffee value chain the following organizations and institutions participate as supporters:

Government institutions

The Government of Ethiopia plays an indisputable role in providing various support service to the overall coffee sector. Regional bureaus of the Agriculture and Natural Resource Development and its descendant organs at zonal and District level are responsible for implementing extension services and other on-farm aspects relating to coffee and other crops. The extension unit at *kebele* level is organized constituting three extension agents for crop production, animal husbandry and natural resources. Due to staff turnover and other institutional capacity gaps, this number may even fall to one.

At District and zonal level however, the marketing and cooperatives development sector has been frequently restructured where-by in some occasions it is merged within the Agriculture and Natural Resource Development section and in other cases it is established as separate section.

The other key supporting institution is ECX. Established in April 2008, following the passing of Proclamation No-551/2007, by the Ethiopian Parliament, the Exchange defines itself as "a marketplace, where buyers and sellers come together to trade, assured of quality, quantity, payment and delivery". Besides coffee, sesame, haricot beans, maize, and wheat are traded in the ECX floor. In response to the critics of its failure to guaranteeing coffee traceability for specialty or certified market, ECX has come up with a new platform – Direct Specialty Trade (DST) (ECX, 2010).

Table 8. Certified coffee value chain actors with opportunities and constraints.

Value chain actors	Functions	Opportunities	Constraints
Input suppliers:- farmers, Coops, Union, farm tool retailers	Supply inputs like coffee seeds and seedlings, small farm tools, organic fertilizer (compost), coffee shade tree seedlings, bamboo strip made coffee collection baskets, and jute sacks	✓ Government support ✓ Availability of research institutes ✓ Market demand for inputs ✓ Seedling raising and supply seen as a profitable business	✓ Uncontrolled seedling production and distribution is a threat ✓ Limited availability of better quality coffee seedlings ✓ Shortage of inputs for production and postharvest ✓ There are few traders of manufactured inputs (polyethylene tube, jute bags, tools etc.) ✓ Weak coffee nursery management capacity of cooperatives
Coffee producers: Smallholder farmers	**Production:** Coffee shade tree planting, coffee planting holes preparation, planting and caring coffee seedlings and mother coffee tree management **Harvesting and supplying produces:** Hand picking red cherries and deliver the produce to coops within 24 hours of harvesting time	✓ High global market demand for certified coffee ✓ Government and NGO support to expand production with quality ✓ Different coffee development national programs ✓ Favorable agro ecology and environment to produce coffee that comply with various certification schemes	✓ Low level of knowledge on improved agronomic practices and very old trees. ✓ Low compost using practice, reduced productivity ✓ Extreme climate variability resulting in disease spread, reduced productivity ✓ Law precautions taken to protect coffee diseases ✓ Poor harvesting techniques, packaging & labor shortage during harvest ✓ Lack of access to transport, road infrastructures, credit and shortage of household income
Collecting & Processing: Coops and SCF Union	**Collection, Sorting, Processing & Exporting:** Purchasing and bulking red cherry coffee, primary	✓ Government and NGO support ✓ Direct access to better international market	✓ Underdeveloped organizational and business management skills ✓ Lack of capacity to implement certification standards ✓ Insufficient collateral to access credit from the bank

	grading/sorting, wet & dry processing, drying and packing, exporting	✓ Increased participation of smallholder farmers ✓ International roasters and importers making huge investments for creating stronger partnerships with farmers and cooperatives at origin	✓ Limitations to provide market information to members ✓ Attitudinal problem of regarding certifications as irrelevant ✓ Reduced supply of coffee as farmers shift to other crops ✓ Competition from newly emerging private voluntary sustainability standard supply chains ✓ "… *a growing gap between the volumes of standard compliant coffee available at producer level and the volume actually procured as standard compliant coffee with the buyer" (Panhuysen & Pierrot, 2014).*

Research institutes and universities

The Ethiopian Institute of Agricultural Research (EIAR) is the leading role player in managing various research centers and sites that specialize according to different agro ecological characteristics. Jimma Agricultural Research Center (JRC) primarily focuses on conducting research on coffee and releases improved coffee seed varieties. Taye, *et al.*, (2011) indicated that the research center has released 37 coffee varieties (and counting) along with improved agronomic and processing techniques. The task of producing and supplying coffee seeds and seedlings at national level has been primarily carried out by this institution and this has become beyond its capacity. Over the years the demand for coffee seeds have been increasing rapidly yet the supply side has depicted worrisome progress.

Apart from this, Universities and other academic institutions contribute in an effort to boost the competitiveness to the value chain, through training and educating competent human resource. Among numerous such efforts, it is worth nothing the research initiative being carried out by Hawassa University – Chemistry Department, in collaboration with TechnoServe Ethiopia. The University with other partners is conducting research on mitigation of environmental pollution and waste water management related with rural wet processing centers. In doing this it seeks to promote better water use efficiency, reduced/no natural rivers and streams contamination by the waste water from the coffee washing facilities, and enhance organic compost making from coffee pulp (Interview with TechnoServe Business Advisor).

NGOs

The role of various national, multinational and bilateral agencies funded development projects has always been a critical success factor for transforming agricultural value chains. In this regard the works of USAID, TechnoServe Ethiopia and other organizations are involved. The USAID funded "Feed the Future AGP-Agribusiness Market Development" project is US Government's largest contribution to the Ethiopian Government's Agricultural Growth Program (AGP) and Agricultural Transformation Agency (ATA) national strategies, which aims to sustainably reduce poverty and hunger by improving the productivity and competitiveness of selected value chains (coffee, sesame, chickpea, honey, maize, and wheat) that offer jobs and income opportunities for rural households. Moreover creating an enabling environment for traceability and improvements in quality are key objectives (USAID 2015).

Similarly TechnoServe (a non-profit organization), is undertaking projects that focus on supporting producer organizations to improve coffee quality and expand specialty coffee sales, training farmers on improved agronomic practices and mitigate the problem of environmental impact of rural wet mill processing stations in collaborating with Hawassa University and other partners to promote proper waste water management and disposal of coffee pulp (TechnoServe, 2013).

iii. Value chain influencers

In the certified coffee value chain two major players are identified as chain influencers, the government and the international third party certification bodies. The sectors has been entertaining massive hand of the state followed by various institutional reforms. The Ministry of Agriculture and Natural Resource Development is one of the higher level state organizations which has a power to determine the places and conditions of coffee transaction and quality control, inspect and grant certificate of quality, and issue certificate of competency to persons engaged in coffee export business (Coffee Quality Control and Marketing Proclamation No. 602/2008). The Ethiopia Commodity

Exchange Authority (ECEA) is another regulatory body involved in the marketing system and oversees the implementation of the ECX rules, extend licenses to its members and audit its performance.

International third party certification bodies on the other side also constitute the certified coffee value chain context/influencers. In the Ethiopian context, and particularly in the case of SCFCU, BCS OKO-GARANTIE GMBH Germany, Fairtrade Labeling Organization, Utz Kapeh Foundation, Rainforest Alliance, and Starbucks operate in the certified coffee value chain. The problem in this regard is the high certification cost. Apart from this, in preparing cooperatives, there is lack of technical personnel/consultant firm – with an international accreditation to assist the national movement of certification.

3.2. Value Chain Mapping

The certified coffee value chain map is shown in Figure 1. The map was developed following the step by step procedure of the M4P (Making Markets Work Better for the Poor Project) tool book (M4P, 2008).

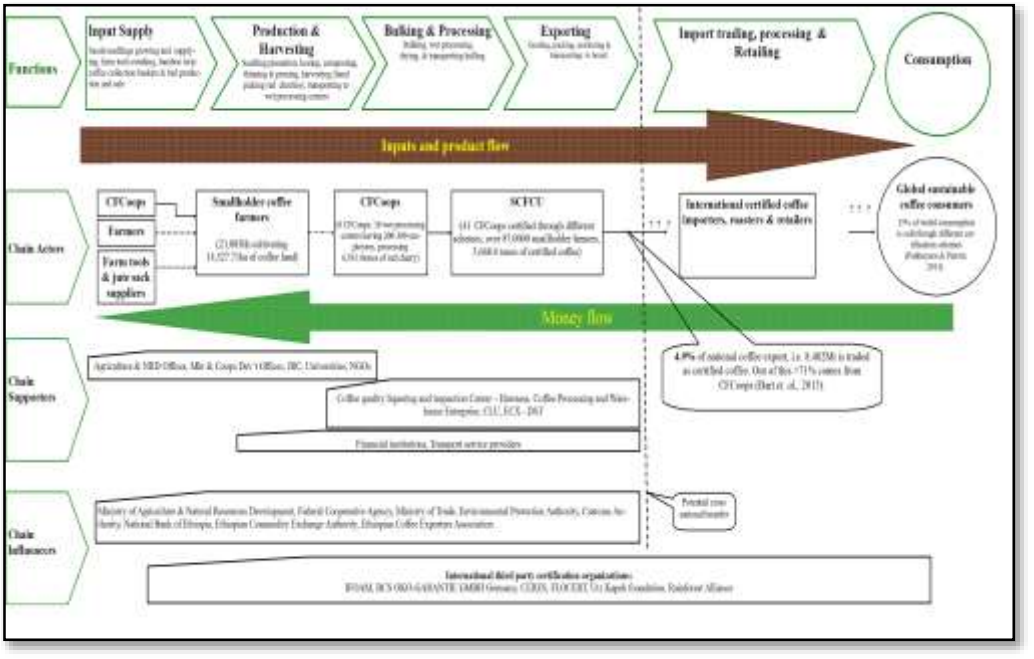

Figure 3 Value china map of certified coffee.

Source: Authors' own sketch.

3.3. Value Chain Governance

Governance refers to the "the inter-firm relationships and institutional mechanisms through which non-market coordination of activities in the chain is achieved" (Humphrey & Schmitz, 2001). Gereffi, et.al (2005) have developed a global value chain governance theory which identified five types of governance structures - hierarchy, captive, relational, modular, and market - which range from high to low levels of explicit coordination and power asymmetry. In light of this brief theoretical background and based on the qualitative and quantitative information available, the certified coffee value chain governance in this study is reviewed from two perspectives. These are the "inter-firm relationships" and "the institutional coordination".

Regarding the "inter-firm relationships" in the value chain, the area of interest is the position of big multinational companies in the global coffee consuming countries and their interactions with voluntary sustainability standards. Internationally the market for certified coffee is growing fast and it is dominated by a handful of transnational corporations. These include: Nestlé, Mondelºe¯z and DE Master Blenders 1753 - and a few big coffee roasters such as Smucker's, Strauss, Starbucks and Tchibo. 40% of all the coffee that is consumed worldwide is processed by the ten largest roasters, each having a market share ranging from 1% to over 10%. These numbers show a growing control of the coffee marketing chain by the roasters (Panhuysen & Pierrot, 2014).

The key to such level of power control mainly accounts to the strategic alliances that these coffee roasters have developed with a number of international sustainability standards initiatives, like FLO, Rainforest Alliance and Utz. Apart from this, few have also developed their own private coffee standards systems (e.g. Starbuck's C.A.F.E. Practices and Nespresso's AAA Sustainable Quality Program) as part of their overall corporate strategies. Parallel to these efforts, the companies are also making significant investments in their supply chains (mostly in partnership with development project initiatives), - which often means establishing stronger relationships with farmers and cooperatives at origin (TechnoServe, 2013). The forecast is also in favor of increasing demand for sustainable coffee in Europe and North America.

In contrast to this huge growing market and multi stakeholder collaboration and commitment for inclusion of smallholder coffee farmers – Ethiopia's certified coffee export share stayed small, with the biggest record being 5.3% of the total export in 2011. Even though the share of cooperatives in total exports is still minor (often below 5%), they contributed the lion share in the countries certified coffee exports. From 2010 to 2013, the share of cooperatives' certified coffee export, out of the total national certified coffee exports (which is itself 4.9%, of which 4.3% is from cooperatives) varied between 72% and 83% (Bart *et. al.*, 2015).

Secondly, the institutional coordination mechanisms which govern the production and flow of the product are the other interest areas for identifying leverage points. These mainly deal with local market structural reformations and regulatory measures that have been undertaken by the government to enhance the coffee sector and improve the livelihoods of coffee farmers. The major reforms in this regards include the passing of two key proclamations, (1) Proclamation No. 602/2008, Coffee Quality Control and Marketing Proclamation and (2) Proclamation No-551/2007- that established ECX and subsequent formation of Direct Specialty Trade (DST). Despite these and varied efforts, as discussed above the certified coffee export performance is low and the benefits transmitting to the smallholder farmers is not as promised. Bart *et al.*, (2015) identified that only one-third of the quality premium at the export level is directly transmitted to producers. The quality premiums are used for financing communal investments and much larger part of it is also used for overheads and program management, indicating the prevalence of bigger efficiency gaps in coordinating exports.

In summary, the certified coffee value chain governance is mainly characterized by stronger power from the downstream actors' side (roasters and importers) and supplier incompetency in production and exporting. An increasing global demand for sustainable coffee accompanied with emerging private standards (like what is initiated by Starbuck's Coffee and Farmer Equity Practices and Nespresso's AAA guideline) in the value chain, might further open spaces for strengthened roaster driven governance structure. This form of networking in the value chain may further impose capability concern among the upstream actors (smallholder farmers and cooperatives) in their effort to comply with the emerging standards (IDH, 2014).

3.4. Intensity of Market Participation

The results from the truncated regression model estimated coefficients (Table 4) show that level of participation is significantly influenced by eight explanatory variables. These are age of household head, sex of the household head, education level of the household head, proportion of land allocated for coffee production, annual coffee production), distance to cooperative office, annual agricultural cash income, and trust in cooperative management.

Among these significant explanatory variables, age and educational level of the household head, and distance to the cooperative office were the factors which negatively and significantly influenced the level of participation of smallholder coffee farmers. Besides these the remaining five significant variables have a positive influence on the quantity of certified coffee supplied to the market.

The regression coefficient estimates of truncated regression model are interpreted in the same manner as OLS regression coefficients: for a one unit increase in the predictor variable, the expected value of the outcome variable changes by the regression coefficient, given the other predictor variables in the model are held constant.

The finding in this study regarding the age of households contradicts to that of Wubeshet, 2010; Tium, 2013, who found positive relationships. However as hypothesized in this study, it can be associated with the innovative nature of the scheme, where by younger farmers might appear to be more proactive to adopt new technologies and engage in new initiatives-like the certified coffee value chain. Apart from this, the distance explanatory variable can be explained by the additional costs (either on monitory terms or time and energy) associated with transporting coffee produce to a designated coffee marketing centers. The proximity of the cooperative office for the farmer house reduces the cost of time and labor that the farmer spent in searching for a buyer for his coffee. Bishop and McConnen, 1999, also identified that as the farmer is closer (near) to the cooperative, s/he will have more knowledge about the cooperative and its benefits which further strengthens their participation.

Proportion of land allocated for coffee is among the explanatory variables which has a positive and significant influence on the smallholders' level of participation in certified coffee value chain. As the percentage of land allocated for coffee production increases by 1%, the expected value of the amount of coffee supplied through certified coffee value chain also increases by about 14kgs. Wubeshet (2010) also found that an increase in farm land allocated for coffee land increases the quantity of coffee supplied through cooperatives.

Annual coffee production has also a positive and significant (at 1% level) influence on the market supply. When the amount of annual coffee production increases by 1 kg, the expected amount of coffee supplied through certified coffee value chain also increases by 0.60 kg

Table 9. Truncated regression model estimation of intensity of market participation.

Variables	Coefficient	Robust Std. Err.
Age	-15.81***	3.791
Sex	206.73***	72.747
Grade	-14.12*	8.040
Family size	23.02	27.904
Coffee farming experience	-1.03	4.338
Land allocated to coffee	14.23**	6.585
Annual coffee production	0.60***	0.0713
Years of membership in cooperative	-3.84	3.854
Distance to local coffee spot market	-50.10**	22.146
Perception on the benefit of market participation	30.73	48.737
Access to coffee market information	143.12	100.045
Access to credit	-122.56	78.793
Frequency of extension visit	2.33	4.280
Annual agricultural cash income	0.017**	0.007
Farmer's degree of agreement to bylaws and delivery obligation	99.35	65.990
Summated multi-item Likert scale	55.68***	12.461
Constant	-1450.33	575.333
/sigma	274.64	29.716
Observations	155	
Limit: lower = 0 , upper = +inf		
Wald chi2(16)	5749.6	
Log pseudo likelihood	-1058.9***	

*Note: ***, ** and * represent 1%, 5% and 10% significance level, respectively.*

Source: Model output (2016).

Annual agricultural cash income is the other explanatory variable which affected the market supply of coffee both positively and significantly (at 5% level). The variable measures the amount of estimated cash income earned from different agricultural activities (excluding coffee) which includes: sale of cereals, fruits and vegetable, livestock, agro-forestry and other timber products. The regression outcome shows that as the average annual farm income from of the smallholder coffee farmer increases by birr one, the expected amount of coffee supplied through the certified coffee value chain increases by 0.02 kgs.

Trust on cooperative management is the other explanatory variable having a positive and significant (at 1% level) influence on the dependent variable. The result further indicates that a unit increase in the mean score of the Likert-scale proxy variable will be accompanied by 55.68 kgs increase in the expected amount of coffee supplied through the certified coffee value chain, other things held constant.

4. Conclusion

The objective of this study was to analyze certified coffee value chain and identify determinants of smallholder farmers' level of participation in the chain. Accordingly in the value chain analysis the study identified value chain actors including input suppliers, smallholder coffee producers, coffee farmers cooperatives, Sidama Coffee Farmers

Cooperatives Union (SCFCU), and international certified coffee importers and roaster. Under the value chain supporters category the government institutions at various level, research institutes and Universities, and NGOs were identified. The government through the top level ministries plays regulatory function in the overall agriculture and export trade sector, including coffee. Besides this international third party certification bodies set standards demanding all actors in the value chain to comply (from producers to cooperatives to international coffee importers and roaster).

The value chain analysis also identified constraints and opportunities in the value chain. The major constraints identified include underdeveloped organizational and business management systems, lack of capacity to adequately implement different sustainability certification standards, gaps in coffee quality inspection skills and facilities, lack of quality payment system at smallholder level, attitudinal problem of considering certification investments and compliance measures as irrelevant/less important, higher cost of certification, insufficient collateral for credit guarantee from the bank, low level of female participation at leadership level, limitations to provide market information at the smallholders level, management gaps (efficiency and environmental impact mitigation) in wet processing machines, gaps in marketing and export trade promotion skills.

The results of the econometrics model indicated that sex, proportion of land allocated for coffee, trust in cooperative management, annual coffee production & agricultural cash income influenced the quantity of coffee supplied to the certified coffee market positively, while age, education level, and distance from the cooperative office have a negative influence. The results indicate that, in the study area, smallholders' participation in the certified coffee value chain is mainly determined by the farmers' physical access to marketing center, their coffee production and productivity, level of agricultural income and the level of cooperative management trust and transparency.

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10. Value Chain Analysis of Haricot Bean (Phaseolus Vulgaris L.): A Case Study in Enebse Sar Midir District, Northwestern Ethiopia

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Abstract

Addition of values to agricultural commodities is a major driving force for transformation of the agricultural economy and it is an indicator of how the agriculture industry shifts to meet increasing global competition. Haricot bean is now becoming one of the most reputable crops that calls urgent value chain interventions in its transaction process. This study was undertaken in Enebse Sar Midir district, northwestern Ethiopia, with the objectives of tracing the commodity's value chains, identifying market channels, evaluating the roles of value chain actors, and examining challenges and opportunities within the haricot bean value chain. Data were gathered using formal surveys administered on various haricot bean traders and descriptive tools were used to analyze the collected data. The result revealed that a total of 15,200 tons of haricot bean was produced in the district out of which 13,468 tons pass through the commodity's value chain. In the haricot bean value chain, 7 market channels were identified. The commodity's flow and share of each actor depict that haricot bean value chain is governed by wholesalers who reside in Addis Ababa. Market concentration measures indicated that markets were found to be strongly oligopolistic (at wholesalers level) and inefficient in structure (with wide final consumers' price spread). Actors handling the commodity with better value additions were found to take the highest share of consumer prices. Gross marketing margin was maximum for city wholesalers (38.60%) and minimum for farmer traders (13.22%). Net marketing margin was maximum (11.52%) for processors and minimum (7.36%) for rural assemblers. In order to reduce market risks of producers and marketing actors it is necessary to encourage production of haricot bean and there by improve nutrition and food security. Contractual agreements between traders and producer farmers are also important to improve farmers' trust on future markets thereby increasing product surplus and contributing to value chain development.

Keywords: Haricot bean; margin; market concentration; market efficiency; oligopoly; value chain actors

1. Introduction

Haricot bean (*Phaseolus vulgaris* L.) is an important cash crop widely consumed worldwide. Diverse cultivars of haricot beans (mottled, red kidney, white and gray) are produced by smallholder growers for commercial export. Despite increases in the export of haricot beans over the last few years, improvements in quality and yield were limited by the availability of quality seed. Many smallholders were still forced to work with uncertified seeds that produce low yields and which are not resistant to disease. In addition, poor

agronomic practices also contributed to low yields of haricot bean at smallholders level (USAID, 2011).

Haricot beans are used as source of foreign currency, food crop, means of employment, source of cash, and plays great role in the farming system (CSA, 2005). Haricot beans may be consumed in various forms, dry seeds, green pods and green-shelled seed (Kay, 1979; Singh, 1999). According to Bennink (2005), there is an increasing demand for common bean in the world because of its significance to human nutrition as a source of proteins, complex carbohydrates, vitamins, and minerals.

Haricot bean is becoming one of the dominant export crops of Ethiopia. However, the share of pulses in general in the export market has been limited by external demand for quality (Gezahegn and Dawit, 2006). Many parts of Ethiopia including East Gojjam (Enebse Sar Midir District), Wollo, Rift valley areas and areas in the southern Ethiopia are suitable for haricot bean production (EIAR, 2004). Despite the nutritional and economic importance of haricot bean, various factors contributed for the existence of inefficient markets. Poor marketing practices, price instabilities, and poor handling practices are prevailing and these have discouraged producers. The problems in turn resulted in supply shortage in the area (BoARD, 2011). As a result, improving the market structure and efficiency should be a priority for improving the supply and help the producers to be beneficiaries. In order to achieve this, nature of the marketing channels, activities of the marketing actors and existing constraints and opportunities need to be analyzed. Thus, this study was initiated to investigate the different marketing channels and analyze the marketing margins along the market chains linking the market in the study area to the foreign, national, and regional haricot bean markets. The research was undertaken with specific objectives of tracing value chains of haricot bean together with identification of the various market channels; evaluating the added values and quality upgrades in the value chain; and examining the challenges and opportunities within the haricot bean value chain.

2. Materials and Methods

2.1. Description of the Study Area

Enbise Sar Midir District is one of the different districts in East Gojjam. The district is bordered by Enarj Enawga district to the south, by Goncha Siso Enese district to the west, and by the Blue Nile River to the north which separates it from the South Gondar Zone and South Wollo Zone. The administrative center of this district is Mertulemariam. The highest elevation of the district is 3,664 meters. The Blue Nile River is crossable at a point that connects Enebise Sar Midir district with Sayint district in South Wollo.

2.2. Data Collection

Data on total output, number of haricot bean traders, and price of haricot bean were taken from secondary sources, which include zonal and district level agriculture offices and Central Statistical Authority (CSA) of Ethiopia. Primary data were gathered from haricot bean traders using a pretested questionnaire. Group discussions and key informants interviews were also undertaken. A total of 110 haricot bean traders were selected using a two stage sampling method. In the first stage, market centers were selected purposively based on their haricot bean production potentials. In the second stage, based on proportion of traders in each market center, the total sample size (110) was proportionately shared among these market centers and respondents were taken at random. Respondents taken from each marketing actors (farmer traders, wholesalers, assemblers, retailers and other marketing actors) are as shown in Table 1.

Table 1. Sample size of traders.

KA/Town	Farmer Traders	Rural Assemblers	Town Assemblers	City Wholesalers	Processors	Exporters
Mertulemaiam			18 (18)			
Anisa	12 (14)	25 (26)				
Geses	7 (8)	13 (15)				
Addis Ababa				17 (17)	10 (11)	8 (8)
Total	19 (22)	38 (41)	18 (18)	17 (17)	10 (11)	8 (8)

Note: Numbers in the parenthesis represent number of traders actually present in each category.

Source: Own survey, 2015.

2.3. Methods of Data Analysis

Means, percentages, variances, and standard deviations were used to examine the relevant variables. The Structure Conduct Performance (S-C-P) Model was used to analyze the data. This model investigates the relationship between market structure, conduct, and performance. This model has been used by different market researchers to address their objectives (Tamek and Robinson, 1990). As indicators of the market structure and performance, market concentration ratio and marketing margin analysis have been used respectively and while description of the conduct of the red haricot bean market was also made.

Market concentration measure

According to Tamek and Robinson (1990), concentration ratio refers to the number, and relative size of buyers in the market. The concentration of firms in the market is estimated using the common measure of market concentration ratio. Concentration ratio is one of the commonly used methods to measure market structure. It is given as:

$$C = \sum_{i=1}^{4} S_i \quad (1)$$

Where C is the four firm concentration ratio; S_i is the percentage market share of the i^{th} firm for the largest four firms (i=1,2,3,4).

As noted by Kohl and Uhl (1985), concentration ratio of 50% or more is an indication of a strongly oligopolistic industry, 33-50% a weak oligopoly, and less value are for a competitive industry.

Marketing margin

Marketing margin is the difference between the price received by producers and paid by consumers (Tamek and Robinson, 1990). According to Cramer and Jensen (1982), marketing margin is the percentage of the final weighted averages selling price taken by each stage of the marketing chain. The total marketing margin is the difference between what the consumer pays and what the producer/farmer receives for his product. In other words, it is the difference between retail price and farm price (Mendoza and Rosegant, 1995).

Computing the total gross marketing margin (TGMM) is always related to the final price paid by the end buyer and is expressed as percentage (Mendoza and Rosegant, 1995).

$$TGMM = \left[\frac{\text{Consumer Price - First Seller Price}}{\text{Consumer Price}}\right] \times 100 \quad (2)$$

Where TGMM is Total gross marketing margin

It is useful to introduce the idea of 'farmer's portion', or 'producer's gross margin' (GMMp) which is the portion of the price paid by the consumer that goes to the producer. The producer's margin is calculated as:

$$GMM_p = \left[\frac{\text{Consumer Price - Marketing Gross Margin}}{\text{Consumer Price}}\right] \times 100 \quad (3)$$

Where GMMp is the producer's share in consumer price

The net marketing margin (NMM) is the percentage of the final price earned by the intermediaries as their net income after their marketing costs are deducted. Thus, the net marketing margin is calculated as:

$$NMM = \left[\frac{\text{Gross Margin - Marketing Costs}}{\text{Consumer Price}}\right] \times 100 \quad (4)$$

Where, NMM is the net marketing margin.

3. Results and Discussion

3.1. Characteristics of Haricot Bean Traders and Channel Analysis

3.1.1. Types and description of haricot bean value chain actors

Along the marketing channel, there are a number of marketing actors who handle the commodity at different stages in the process of transaction. They together form the link and create the channel beginning from producers until the commodity reaches to the ultimate consumers. These different groups of haricot bean traders include farmer traders, rural assemblers, town assemblers, city wholesalers, processors, and exporters. They all add different values to the commodity along the chain.

Farmer traders

These are generally seasonal traders who actively participate in times of high supply and shift to other farming businesses when market supply of haricot bean vanishes. The informal survey result revealed that on average, farmer traders had about 3 years of experience in haricot bean trading. From the total of farmer traders with whom group discussion was made, 54% of them did not have trade license.

Assemblers

Two types of haricot bean assemblers are known. These are rural and urban assemblers. Assemblers collect large quantities of haricot bean from area of surplus for selling when price increases. Urban assemblers were found to be more experienced and known for their potentials of buying big quantities as compared with the rural assemblers. This is because larger proportion (about 56%) of them are literate and have better access to market information.

City wholesalers

These groups of marketing actors reside in the capital city (Addis Ababa) and collect large volume of the product purchasing from assemblers (from the rural markets or towns or city). They compete for handling big volume of haricot bean through commission agents. Commission agents delegated at different market centers purchase the product with the agreement that they will sell the amount they collected at a price of 0.25 cents increment per kilogram. Wholesalers ultimately sell the amount they collected mainly to exporters and rarely to processors.

Processors

Processors purchase haricot bean with the objective of making big profit through adding value to the product. They process haricot bean and seal the food product in a container of volume about 250ml. This processed delicious product (locally called "Wot") is consumed with bread and "Injera" or without any complementary ingredient. This product may stay for extended period. The result showed that of all the marketing actors, processors took the highest marketing profit (1.65Birr/Kg) next to exporters. The reason is mainly attributed to value addition to the commodity.

Exporters

These marketing actors purchase haricot bean from different haricot bean traders within the country and supply the product to foreign countries looking for better market destinations. The survey result showed that highest marketing profit (3.90 Birr/Kg) was taken by exporters. This is due to the relatively big difference between purchase price (inland) and selling (*fob, i.e.*, free on board) price. The informal discussion with these marketing actors indicated that the absence of competition (existence of only few exporters) helped them easily negotiate among themselves for price determination. This enabled them to make high profit as compared to the other marketing actors.

Table 2. Haricot Bean Marketing Actors' Socio-Demographic Characteristics

Marketing Actors	Sex (% of male)	Age (years)	Trading experience (years)
Farmer traders (N=19)	100	36.12 (4.04)	3.32 (3.45)
Rural Assemblers (N=38)	89.22	29.37 (2.81)	4.71 (3.42)
Town Assemblers (N=18)	100	34.31 (3.44)	6.47 (1.89)
City wholesalers (N=17)	100	35.40 (3.63)	7.04 (3.03)
Processors (N=10)	100	38 (3.61)	8.60 (2.51)
Exporters (N=8)	91.98	37.21 (3.37)	7.61 (2.30)
Total (N=110)	100	38.82 (4.55)	7.82 (2.15)
F/ χ^2-Value	13.81*	4.93***	11.04***

*Note: *** and * show statistical significance at less than 1 and 10% probability levels; Numbers in the cells are mean and standard deviations; N=Sample size.*

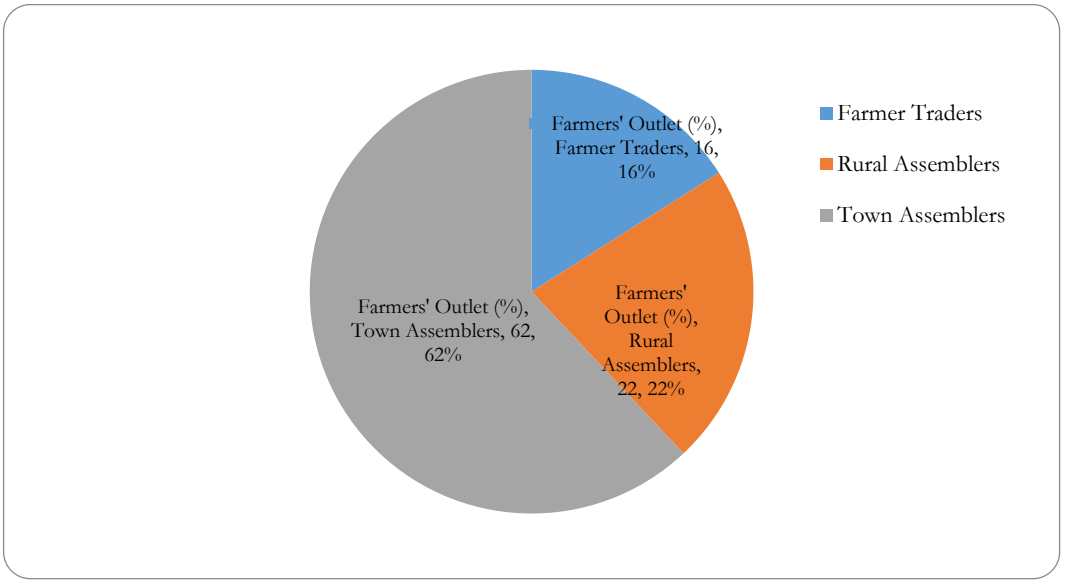

Figure 1. Proportion of volume of haricot bean directly purchased from producers (%).

3.1.2. Value chain support

Haricot bean value chain is characterized by a weak support from stakeholders. The only supporter is the Enebse Sar Midir district Agricultural Office that assists the sector especially in implementing production packages. Practical evidences in the area depict that haricot bean business is challenged by absence of stakeholders that provide capacity building, financial, technical and market stabilizing -supports.

3.1.3. Haricot bean market channels

Following the direction of flow and volume of haricot bean transacted, seven marketing channels were identified. The channel starts from the producers and ends in consumers passing through a number of marketing actors along the chain. According to the Enebsie Sar Midir district (2015) agricultural office report, a total of 15,200 tons of haricot bean was produced. Of this, the amount that was transacted during the year was found to be 13,468 tons. Because of the special nature of the commodity, the flow channel was found to be long and complicated. In order to quantify the volume of haricot bean handled by each marketing actor along the marketing chain, the total purchased amount was multiplied by the share of each marketing actor as obtained from the survey. Following the channels depicted in Figure 2, the following marketing channels were identified:

Channel 1. Producer → Farmer Traders → Rural Assemblers → Town Assemblers → City Assemblers → City Wholesalers → Exporters → Consumers

Channel 2. Producer → Farmer Traders → Rural Assemblers→ Town Assemblers → City Assemblers → Processors → Consumers

Channel 3. Producer → Farmer Traders → Rural Assemblers→ Processors → Consumers

Channel 4. Producer → Rural Assemblers→ Town Assemblers → City Assemblers → City Wholesalers → Exporters → Consumers

Channel 5. Producer → Farmer Traders → Rural Assemblers→ Town Assemblers → City Wholesalers → Exporters → Consumers

Channel 6. Producer → Farmer Traders → Rural Assemblers→ Town Assemblers → Exporters → Consumers

Channel 7. Producer → Town Assemblers → City Assemblers → City Wholesalers → Exporters → Consumers

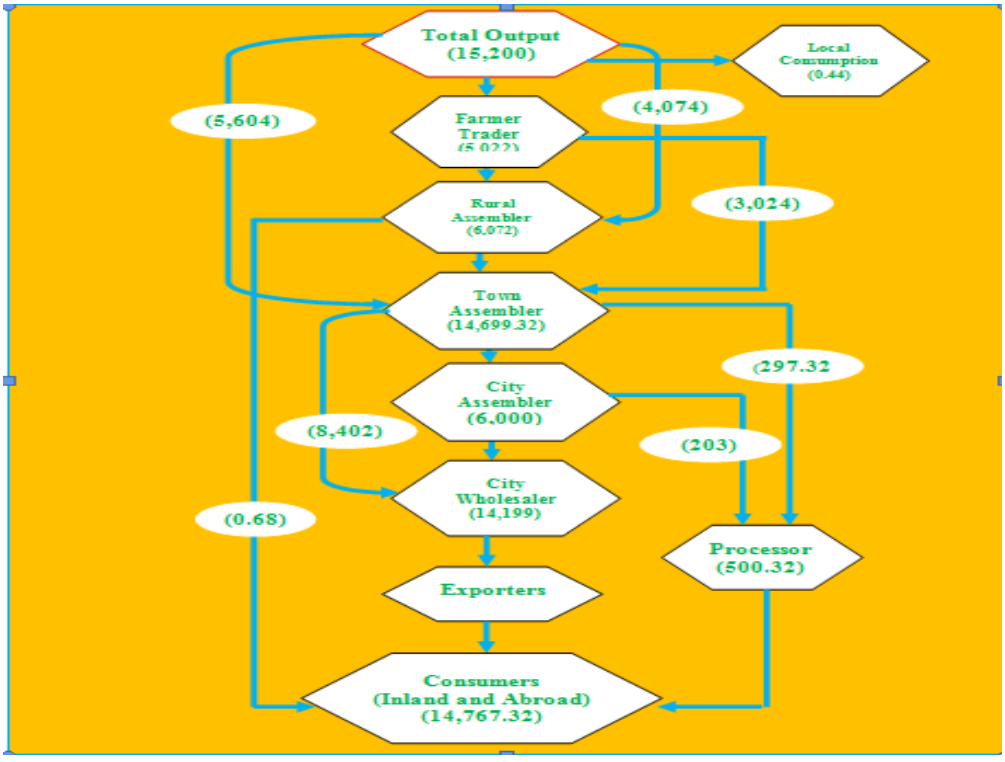

Figure 2. Market Channels of haricot beans.

Note: Numbers in the parentheses represent tons of haricot bean. The difference, 432.68 tons (15,200 tons-14,767.32 tons) is attributed to local consumption and losses due to pest and spoilage.

3.2. Market Structure and Performance of Haricot Bean

In order to evaluate the market structure of red haricot bean, the following indicators were used:

3.2.1. Market structure

Market structure was assessed by computing four-firm market concentration ratios. Degree of market concentration in Mertulemariam and Addis Ababa showed that haricot bean is handled by few individuals and thus the haricot bean market is oligopolistic in nature. In the above regional markets, the 2011 annual volume of haricot bean purchased was taken in order to calculate the concentration ratio in the markets considered (Mertulemariam and Addis Ababa).

The concentration ratio had indicated the existence of oligopoly market structure in the three markets considered in different degrees (Table 3).

Table 3. Concentration ratio of the haricot bean markets considered.

Markets	Concentration ratio for the four big firms (%)
Mertulemariam (Town Assemblers)	55.82
Addis Ababa (City Wholesalers)	66.42
Addis Ababa (Exporters)	44.11

As seen in Table 3, the four relatively big wholesalers (city wholesalers) in Addis Ababa took 66.42% which is an indication of a strong oligopoly market structure of the commodity followed by town assemblers in Mertulemariam having a share of 55.82% from the annual volume of haricot bean transacted (Kohl and Uhl, 1985). The amount taken by exporters in Addis Ababa is relatively smaller (44.11%) depicting weak oligopoly. This is due to the reason that the existing number of exporters is smaller which is in turn due to entry barriers (mainly financial) to the market. Some of the major entry barriers indicated by the actors include the following:

Capital

Capital is the primary barrier to enter haricot bean marketing. The survey result indicates that about 46% of farmer traders, 48% of rural assemblers, and 41% of city wholesalers and 37% of exporters confirmed that capital is the primary factor that blocks many people from entering haricot bean marketing. Lack of guarantee to take credit from banks and unavailability of credit services has also contributed to financial scarcity. The only available credit service in the district is the Amhara Credit Service Institute. However, due to its high interest rate, 62.08% farmer traders and about 47.56% town assemblers confirmed that they refuse to take credit from this credit service institution.

Lack of training

The survey result indicated that there has been no training or consultancy service provided to the marketing actors regarding haricot bean marketing. About 100% of farmer traders, 97% rural assemblers, 88% of city wholesalers and 81% of exporters showed a strong desire of taking training if provided.

Education level

The result indicated that in all marketing actors, less than 50% responded that they attended formal education. Price information, market prediction, and addition of value to the product are functions of the literacy level. Of all the marketing actors, all the exporters were found to be literate (completed formal school of 12 grade).

3.2.2. Marketing performance

Marketing margins were computed to assess performance in haricot bean market. The marketing margins calculated for each marketing actor show that there is a large difference in the consumers' price spread along the marketing chain. Wider marketing margin indicates high price to consumers and low price to producers and it is an indicator of the existence of imperfect markets (Cramer and Jenson, 1982) though markets may fail due to many reasons.

Table 4. Marketing margins along the different marketing channels.

Marketing Margins	1	2	3	4	5	6	7
TGMM	56.23	61.36	68.40	60.31	58.46	60.20	46.14
GMM_{ft}	16.86	24.71	13.22		33.41	28.12	
GMM_{ras}	22.20	16.54	14.31	11.54	17.53	16.37	19.25
GMM_{tas}	36.23	34.12		29.81	32.19	30.81	29.77
GMM_{cws}	38.60			10.61			
GMM_{prc}				34.43			32.79
GMM_{exp}	32.11		8.90	31.27	30.03	33.25	31.66
NMM_{ft}	8.23			9.44		8.43	7.80
NMM_{ras}	7.36	8.10			8.11		
NMM_{tas}	7.54		7.64	7.88			7.98
NMM_{cws}	7.21			8.97	10.32		8.46
NMM_{prc}	11.52	7.67	7.12	10.20		9.71	11.00
NMM_{exp}	8.93	7.83	7.65	8.00	8.74	10.43	9.11

Note: TGMM=Total Gross Marketing Margin, NMM=Net Marketing Margin, ft=Farmer Traders, ras=Rural Assemblers, tas=Town Assemblers, cws=City wholesalers, prc=Processors, exp= Exporters.

According to Cramer and Jenson (1982), wide marketing margins are evidences for the existence of inefficient markets although high marketing margins can also arise due to high real marketing costs and a very big producer and consumer price difference.

The marketing profit was quantified by subtracting the sum of purchase price and the marketing cost from the selling price for each marketing actor in each marketing channel.

The result revealed that profit was found to be highest (3.90 Birr/kg) for exporters in channels 1, 3, 4 and 7 followed by processors (1.65 Birr/kg) in channel 3. Kindie (2007), in his market chain analysis of sesame, noticed a similar trend. This is due to relatively high export prices (for exporters) and significant price increment after value addition (processing).

To the contrary, the least marketing profit (0.20 Birr/kg) is for farmer traders, town assemblers, and city wholesalers in channel 1. The reason may be attributed to high purchase price and relatively low selling price (due to high bargaining power of buyers in the channel). Discussion made with key informants indicated that these marketing actors incur high marketing costs (brokerage, transport, packaging, and grading). The result also indicated that super imposition of unaffordable taxes to the town assemblers and city wholesalers is one of the reasons that made them incur big cost of haricot bean transaction.

The relatively big variation in marketing profit is mainly because of the existence of wide marketing margins (due to differences in the spread of the final consumers price spread among the marketing actors), which is a clear indicator of inefficient markets.

Table 5. Marketing profit of haricot bean traders (Birr/kg) for selected channels.

Marketing agents		1	3	4	7
Farmer	Purchase price	6.75	6.75		
traders	Marketing cost	0.55	0.55		
	Selling price	7.50	7.50		
	Marketing profit	0.20	0.20		
Rural	Purchase price	7.50	7.50	7.00	
Assemblers	Marketing cost	0.50	0.40	0.30	
	Selling price	8.25	8.50	8.55	
	Marketing profit	0.25	0.60	1.25	
Town	Purchase price	8.25		8.25	7.10
Assemblers	Marketing cost	0.35.		0.35	0.40
	Selling price	8.80		8.80	8.30
	Marketing profit	0.20		0.20	080
City	Purchase price	8.80		8.80	8.80
Wholesalers	Marketing cost	0.30		0.35	0.35
	Selling price	9.30		9.30	9.30
	Marketing profit	0.20		0.15	0.15
Processors	Purchase price		8.25		
	Marketing cost		0.30		
	Selling price		10.20		
	Marketing profit		1.65		
	Purchase price	9.30	9.30	9.30	9.30
Exporters	Marketing cost	0.45	0.45	0.45	0.45
	Selling price	13.65	13.65	13.65	13.65
	Marketing profit	3.90	3.90	3.90	3.90

Note: The export prices are fob (free on board) prices.

3.3. Opportunities and Major Challenges

3.3.1. Opportunities

1. Enebse Sar Midir has huge haricot bean production and surplus potential that can cover the needs of traders at regional and national levels. Reports of the Ethiopian Commodity Exchange (2014) depict that the area is the major source of white and red haricot bean to the national and international markets.
2. By its very nature, haricot bean is not easily susceptible to spoilage and damages during transportation and have long shelf life. This implies that the product can easily be handled by various actors at different levels in the chain.
3. There is big focus and increasing tendency towards production of cash commodities. Producer households are earning better incomes than ever before.
4. The international market demand for the product is alarmingly increasing each year. This has called poor households to involve in production and marketing.

3.3.2. Major challenges

1. Haricot bean value chain lacks supporters. The only stakeholder available is the district Agricultural Office that supports the sector by delivering production packages and distribution of better inputs. Better performing varieties are not available for producers each year; they use their own (old) varieties.

2. There is no pre-stated standards for the commodity. This has posed a big challenge for setting prices at regional markets (especially for producers). The best and least standard haricot bean are sold by the same price in this regard.
3. Producers have low level of awareness and they allocate a very small proportion of their plots for the commodity.
4. There is no conducive value chain financing services with optimum interest rate.
5. There exist high price instabilities and because of this farmers lack trust to produce more of the commodity.
6. There is no contractual agreements between a responsible stakeholder and producer farmers for guaranteeing prices.

4. Conclusion and Recommendations

Reduced market risks of producers and value chain actors can be brought by value addition interventions that can in turn lead toward transformation of the agricultural economy. The concentration ratio of the four relatively bigger firms indicated that there exist a strong oligopoly market structure depicting that the commodity is handled by few individuals (traders) indicating that competition is very less resulting into market inefficiencies.

There is a high demand for haricot bean for its nutritional importance to the ultimate consumers and as source of cash to the producers. Enebse Sar Midir district is one of the major supply sources of haricot bean in Ethiopia. However, most of the output is transacted and handled by few traders. Due to lack of financial capital, many traders failed to enter haricot bean marketing. All these factors contributed for the strongly oligopolistic nature of the commodity market and poor marketing performance and efficiency.

Haricot bean value chain is governed by wholesalers who reside in Addis Ababa. These actors have the market power of making prices and managing the market supply (can create pseudo supply scarcity). Of all the marketing actors, processors were found to earn high profit next to exporters portraying that passing the product with some value addition could help marketing actors make high profit in the respective marketing channel.

To empower producer farmers and many interested traders, there should be training and financing service delivery, which will ease entry to the market. This will ultimately foster competition and improve the market structure thereby fostering value chain development. Furthermore, it is important to encourage adoption of haricot bean by farmers to improve nutrition and food security. In addition, contract agreements that can be made between producer farmers and market actors can increase farmers' trust on future markets. Therefore, in order to maintain production at surplus and good market opportunities, such agreements should be encouraged.

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11. Value Chain Analysis of Beef Cattle in Wolaita and Hadya Zones, Southern Ethiopia

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Abstract

The study was conducted in Sodo Zuria and Misrak Bedwacho districts of Wolaita and Hadya zones, respectively, in southern region of Ethiopia, with the general objective of analyzing beef cattle value chain. A multi-stage random sampling procedure was applied to select beef cattle value chain actors. A total of 154 farm households, 15 beef cattle traders, 29 beef retailers (butchery and hotel/restaurant owners), and 30 consumers were selected and interviewed as beef cattle chain actors. The benefit shares of the main beef cattle value chain actors were determined using the gross margin analysis. Multiple linear regression model was used to determine the major factors affecting the value of beef cattle supplied to the market. Among the determinants identified, the level of education of household head, family size, income generated from other sources, and total land holding per household positively and significantly affected the value of beef cattle supplied to the market. On the other hand, the distance of farmers' residence from the nearest cattle market negatively and significantly affected the value of beef cattle supplied to the market. Moreover, the calculated benefit share among beef cattle value chain actors indicated that the highest proportion of the benefit (65.6%) accrued to beef retailers followed by beef cattle producers or farmers (20.5%) and beef cattle traders (13.9%). However, farmers incurred high production cost (on average ETB 1284.49) for fattening purpose, while beef cattle traders and beef retailers incurred on average ETB 200.00 and 382.41, respectively. Therefore, though farmers supplied beef cattle after long time duration on feeding and proper management (in most cases 3-6 months of fattening period) incurring high production costs, they received the lowest gross profit as compared to the other chain actors. Therefore, this study revealed that consistent capacity building for concerned stakeholders as an important strategy to benefit the rural poor. In addition, proper and timely provision of support services is mandatory. Government bodies should give emphasis to the market accessibility for beef cattle producers through organized cooperatives in order to improve the farmers' benefit from beef cattle value chain.

Keywords: Beef cattle value chain; gross margin; value added; value chain governance.

1. Introduction

Ethiopia, like most of the countries in Sub-Saharan Africa, is heavily dependent on agriculture. Livestock production is an integral part of Ethiopia's agricultural sector and plays a vital role in the national economy (CSA, 2014). However, the existing income generating capacity of livestock is very low compared to its immense potentials (MoARD, 2013). Meat production is an important activities in the Ethiopian economy of which ruminants contribute over 3.2 million tons, representing over 72% of the total meat production in the country (Belete *et al.*, 2010). However, the actual consumption of beef is seriously restricted by the low purchasing power of the majority of the consumers, for whom retail prices are already too high (AGP-LMD, 2013).

Recently, there has been great emphasis to commercialize beef cattle production in Ethiopia to enable the sector to contribute more effectively to household food security, and income as well as to the national economy. Beef cattle fattening has been earmarked as one among several means to improve beef cattle production through value addition (AGP-LMD, 2013). The word value addition can be defined as the additional value of a commodity over the cost of inputs used to produce it from the previous stage of production or the value added to any product or service as a result of a particular process (Anandajayasekeram and Berhanu, 2009). It is also possible to add value through cost reduction as a result of increasing productivity. To enhance opportunities for value chain actors, we need to understand the main value chain actors constituting the entire value chain for beef production (Harko, 2015). In Ethiopia, the supply chain is dominated and controlled by many middlemen at primary, secondary and terminal markets (UNILO, 2009). Such interferences influence the commodity value chain at each stage. The aim of this study is to identify and analyze the beef cattle value chain in Wolaita and Hadya zones of Southern Ethiopia.

Specific objectives are:

- To identify beef cattle value chain actors and their roles in the chain;
- To determine the benefit share of the chain actors; and
- To determine factors affecting value of beef cattle supplied to the market.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in two zones of Southern Nation Nationalities and People Regional State (SNNPR), Ethiopia. The farming system of these zones in general is mixed crop-livestock farming system. The area is ~~a~~ densely populated with a maximum of about 670 persons per km^2 (Million, 2003). The total number of cattle population in SNNPR was estimated to be about 11.2 million of which 798,067 (7.1%) and 819,467 (7.3%) were found in Wolaita and Hadya zones, respectively (CSA, 2014). Based on beef cattle fattening potential, two districts were purposefully selected for this research, one from each zone. These are Sodo Zuria district from Wolaita zone and Misrak Bedwacho district from Hadya zone. Six representative *kebele* were randomly selected from the two districts.

2.2. Data Types, Sources and Methods of Data Collection

Both primary and secondary data were used for this study. The primary data were collected from primary sources such as beef cattle producers, beef cattle traders, beef retailers (butcheries and hotel/restaurant owners), and beef consumers. Secondary data sources include both published and unpublished documents. A total of 154 farm

households were randomly selected from six rural [1]kebeles (three from Sodo Zuria district and three from Misrak Bedwacho district) for interviewing. Similarly, 15 beef cattle traders, 29 beef retailers, and 30 beef consumers were purposely interviewed as the main beef cattle value chain actors. Using the pre-tested questionnaire, relevant information was collected from sample respondents. Moreover, representatives from beef cattle slaughter houses in both districts and animal health professionals from Sodo regional veterinary laboratory were interviewed to substantiate the information gathered from the aforementioned respondents. At the same time, market assessment and interview of key stakeholders were made using a checklist.

2.3. Data Analysis

Both descriptive statistics and econometric analysis were used to analyze the data collected from different sources. The data were analyzed using Stata and SPSS software.

2.3.1. Value chain mapping and analysis

As products move successively through the various stages, transactions take place between multiple chain actors, money and information are exchanged and value is progressively added. The main aspect of beef cattle value chain analysis, therefore, was applied using some quantitative and qualitative analysis. First, an initial map was drawn which illustrates the structure and flow of the chain in logical clusters. Mapping beef cattle value chain actors presented the chain actors, their linkages, and all the major operations of the chain from pre-production to consumption. After having developed the general conceptual map of the value chain, the economic performance of the chain and benefit share of actors were analyzed.

2.3.2. Econometric model specification for determinants of value of cattle supplied

Multiple linear regression was used to analyze factors affecting the value of beef cattle supplied to the market. This model was selected for its simplicity and practical applicability to show the linear relationship between the response variable and the predicators (Greene, 2003). The multiple linear regression model was specified as Y = f (family size per household, educational level, age, sex of household head, income generated from other sources, livestock holding, distance of farmers residence from the nearest cattle market, access to extension services, access to market information, experience in fattening, access to credit, and presence of brokers). The econometric model specification in matrix notation was specified as:

$$\gamma = X\beta \quad (1)$$

Where: Y = value of beef cattle supplied to the market by individual farmer (ETB)

X = Predictor

β = A vector of parameters to be estimated

2.3.3. Calculating the Benefit Share of the Actor in Beef Cattle Value Chain

To determine the benefit share of each actor along the beef cattle value chains, the costs and margins were identified and calculated. Identifying how operational and investment costs are currently distributed over the actors in the beef cattle value chain helps to know whether it is possible for the poor to enter a chain or not. Identifying how revenues and

margins are currently distributed over the actors in the beef cattle value chain helps to assess whether actors, particularly the poor, can increase margins in a beef cattle value chain or not. The aim is to assess the financial position of an actor compared to other actors in a chain. It is computed as:

$$\text{Market share} = \frac{\text{Added value by an actor}}{\text{Total value added by main actors}} x\ 100 \quad (2)$$

2.4. Definition of Variables

Dependent variable

Value of Beef Cattle Supplied to the market: This is the value of beef cattle supplied to the market by individual farmer per year and is measured in ETB (Ethiopian birr).

Independent variables

The following explanatory variables were hypothesized to affect the value of beef cattle supplied to the market or the dependent variable.

Family size: it is a continuous variable and measured in number of persons per household. Family size per household could affect the level of participation of farmers either negatively or positively depending on the level of labor contribution of the family members.

Age of household head: Age is demographic variable and is measured in number of years. Aged households are believed to be wise and acquire skills in beef cattle production to supply more in a given time period.

Sex of household head: This is a dummy variable that takes a value of one if the household head is male and zero otherwise. Both men and women may participate in beef cattle production and contribute in beef sector equally. However, problems such as lack of capital, credit inaccessibility, and poor access to extension service may affect women's participation and efficiency in the use of livestock production technology (Tanga *et al.*, 2000).

Educational level of household head: It is an intellectual capital, measured in terms of attending formal schooling of household head. It is assumed to have positive effect on the value of beef cattle supplied to the market. According to Holvoet (2004) education is an input since it provides the means of earning a higher income via enhancing earning capabilities.

Land holding per household: This is a continuous variable measured in hectares of the total land owned per household. This variable determines the value of beef cattle supplied to the market positively since it determined the feed availability.

Distance to the nearest cattle market: It is a continuous variable and is measured in kilometers that the farmers travel to sell beef cattle. If the farmer is located in a village far from the market, he/she is weakly accessible to the market.

Access to extension services: This variable is measured as a dummy variable taking a value of one if there is access to extension service and zero otherwise. Farmers having access to extension service could access better information and adopt new technology.

Access to credit facility: It is measured as a dummy variable taking a value of one if the household has access to credit and zero otherwise. As a variable, credit access is assumed to have a positive effect on the level of participation of farmers and hence increase beef cattle production and selling.

Experience in fattening: It refers to the number of years the farmer has been engaged in fattening activity. As farmers got more experience in fattening, the probability of increasing production would be higher.

Income generated from other sources: The variable represents income generated from different sources other than beef cattle. The income might be obtained by household head, spouse, and other household members. Through improving capital asset, this income makes the household to expand beef cattle production.

Total livestock holding: This is a continuous variable and indicates the number of livestock other than beef cattle measured in tropical livestock unit. This variable is expected to have positive influence on farmers' participation in beef cattle fattening and marketing.

Above all, before fitting the significant variables into the model for analysis, it is important to test multicollinearity problem among continuous variables and associations among discrete (dummy) variables, which seriously affects the parameter estimates. Variance Inflation Factor (VIF) was used to check the severity of multicollinearity among the explanatory variables.

3. Results and Discussion

3.1. Characteristics of Value Chain Actors

3.1.1. Demographic characteristics of farm households

Among the interviewed respondents, 86.7% and 13.3% are male- and female-headed households, respectively, in Sodo Zuria, and 95.8% and 4.2% are male- and female-headed households in Misrak Bedwacho district, respectively (Table 1). Thus, the participation rate of male-headed households is far higher than that of female-headed households in cattle fattening activities. This might be due to the availability of fewer female-headed households, less capital investment and less technology innovation in case of female-headed households or lack of gender mainstreaming in the provision of agricultural extension. AGP-LMD (2013) revealed that livestock ownership by women constitutes an important component of their asset portfolio that is not bound by most of the legal and property rights, issues such as land.

Table 1. Demographic characteristics of farm households.

Parameter	Sodo Zuria		Misrak Bedwacho	
	%	Mean±STD	%	Mean±STD
Sex of respondent:				
Male	86.7	-	95.8	-
Female	13.3	-	4.2	-
Educational status:				
Illiterate	36.1	-	33.8	-
Only read & write	36.1	-	46.5	-
Primary school	25.3	-	14.1	-
Secondary school	1.2	-	2.8	-
Higher institution	1.2	-	2.8	-
Marital status:				
Married	91.6	-	94.4	-
Single	1.2	-	1.4	-
Widowed	3.6	-	1.4	-
Divorced	3.6	-	2.8	-
Average family size:	-	6.4±2.8	-	6.2±1.6
Average age of respondent:	-	38.8±5.8	-	40.3±7.0

Note: STD: standard deviation

The educational status of farm households (Table 1) indicates that 36% and 34% of them are illiterate in Sodo Zuria and Misrak Bedwacho districts, respectively. About 36% and 47% of them can read and write in Sodo Zuria and Misrak Bedwacho districts, respectively. The figures are more or less similar in both districts. Still it requires great attention to look after about the illiterate classes of the society to improve their educational level. Moreover, 92% and 94% of sample respondents are married in Sodo Zuria and Misrak Bedwacho districts, respectively. The average age of sample households is 38.8±5.8 and 40.3±7.0 years for Sodo Zuria and Misrak Bedwacho districts, respectively. On the other hand, the average family size in Sodo Zuria district is 6.1±1.3 and Misrak Bedwacho has 6.6±1.5 persons per household. In this study, the average family size is consistent with CSA (2007) that revealed the average household size was 6.0 people per household in the rural areas of Southern Ethiopia.

Table 2. Average livestock holding and land size of sampled households (Mean ± STD).

Parameters	Sodo Zuria	Misrak Bedwacho
Average livestock holding (TLU)	3.50+2.10	2.70+1.80
Average Landholding per household:		
Farm land for crop (ha)	0.60+0.30	0.70+0.30
Land for grazing (ha)	0.02+0.10	0.04+0.70

Note: ha: hectare; STD: standard deviation; TLU: tropical livestock unit; TLU conversion factor is adapted from ILCA 1990.

The average land holding per household is less than 0.75 ha in both districts (Table 2). The landholding for grazing purpose is particularly very low in both districts. The very small landholding for crop production and grazing purpose could be a challenge to support the livelihood of the large family sized households in the study areas. The very small grazing land is a reflection of high population pressure pushing for cultivating any

available land including grazing areas. This calls for sustainable intensification of the production systems through improved forage production in small plot of land and using agricultural and agro-industrial by-products as supplementary feed for cattle fattening as strategy for increasing livestock production and income generation. On the other hand, the average livestock holding per household (3.5+2.1) in Sodo Zuria district (Table 2) is a bit higher than Misrak Bedwacho district (2.7+1.8).

3.1.2. General characteristics of beef cattle traders

All the interviewed beef cattle traders are male in both districts, which could be due to culture as well as the need for movement from one place to another to find cheaper cattle sources and better market access for finished animals, which is less convenient for women. Almost all interviewed traders in both districts attended formal education, which is very helpful to improve the business skill and bargaining power. The respondents reported that they have average experience of about 9.8 and 10.5 years of livestock trade in Sodo Zuria and Misrak Badawacho districts, respectively. However, some of the traders have been working for more than thirty years and some are almost the beginners (2 or 3 years of experiences) in beef cattle trading.

3.1.3. General characteristics of beef retailers

In this study, retailers are those who bought beef cattle and slaughter it for the purpose of serving consumers in different forms. The majority (64.7% in Sodo Zuria district and 83.3% in Misrak Bedwacho district) are male-headed households. The study also showed that the majority (52.9% and 83.3% in Sodo Zuria and Misrak Bedwacho district, respectively) can read and write. The remaining respondents attended primary school education and above. Trading is the main source of income followed by butchery for retailers in both districts. The respondents reported that they have an average of about 16 and 14 years of beef retailing experiences in Sodo Zuria and Misrak Bedwacho districts, respectively.

3.2. Beef Cattle Fattening Activities in the Study Areas

Consumption of raw meat (beef) in Wolaita and its surrounding is a common tradition. Because of this cultural reason, Wolaita and Hadya areas are considered to be potential areas in beef cattle fattening. According to MoA (1996), beef cattle fattening practices in Ethiopian context are categorized into three types. These are traditional (backyard), by-product based cattle fattening, and Hararghe cattle fattening. However, in most parts of the rural areas of the country, smallholder farmers finish cattle based on backyard fattening system through utilizing available feeds (GebreMariam *et al.,* 2013). The observation holds true in the current study areas. This might be due to shortage of feed resources and working capital as well as poor skill in beef cattle production. According to GebreMariam *et al.* (2013), backyard fattening is cheaper than feedlot operation. However, it cannot supply large and consistent volume of beef to a commercial abattoir or exporters. Therefore, up-grading producers' skill about proper handling and feeding of beef cattle in general is very crucial. Moreover, capacitating the main actors especially producers is necessary to improve their competitiveness in the chain at large. The important inputs used by beef cattle producers include the beef cattle itself, feeds, veterinary services, water, housing and land, among others. Beef cattle producers in the study areas use various types of production inputs from their own farm as well as from that provided by support service providers in their surroundings.

1. ***Feed sources:*** Beef cattle producers use various feed resources in order to feed their animals. Feed sources in the study areas include natural pasture, crop residues, cultivated forage, root, leaves, tubers, hay, maize, and feeds purchased from local market and neighbor.
2. ***Beef cattle:*** are the initial sources in beef cattle production. Beef cattle might be sourced from retired oxen, bulls, and culled cows or might be purchased from the cattle market.
3. ***Water:*** Beef cattle need drinking water. Water is the most essential nutrient and an important input used by beef cattle production. The water source for animals in the study areas include river, pond, hand-dug well, spring water, and pipe water.
4. ***Vaccine and drugs:*** These are important inputs used during beef cattle fattening.
5. ***Land:*** Land is an important input to produce feed for animals. Currently, the landholding in hectare per household diminishes through time because of population growth and expansion of grazing lands into arable lands to produce crops. Feed shortage is the main challenge because of conversion of grazing areas to cropland.
6. ***Housing:*** Housing is important to protect animals from harsh environmental hazards, theft, and predator. In the study areas, housing beef cattle in confined form especially at the end of the fattening period for two or three months is common.
7. ***Labor force***: It is an important input which is obtained either from family labor or hired.

3.3. Roles of Beef Cattle Value Chain Actors and Service Providers

In beef cattle value chain, many actors are involved at each stage of the chain. According to AGP-LMD (2013), the Ethiopian meat and live animal value chains have developed over the years into a series of complex constituents involving various actors. According to this report, the main actors in meat and live animals include producers, collectors, small private and cooperative fatteners/feedlots, brokers/middlemen, livestock trading cooperatives, individual traders and exporters. Consistent with this report, the current study identified actors and service providers that are involved in beef cattle value chain. Farmers, beef cattle traders, beef retailers, and beef consumers are the main beef cattle value chain actors. Moreover, veterinary service, financial institutions, agricultural offices, brokers, slaughterhouses, and other input suppliers are the major support service providers in the study areas.

3.3.1. Mapping the main actors and support service providers

Mapping the value chain is important to understand the characteristics of the chain actors and the relationships among them, including the roles of all actors in the chain and the flow of specific product through the chain. The following figure illustrates the beef cattle value chain actors and support service providers, their roles, and integration in the chain.

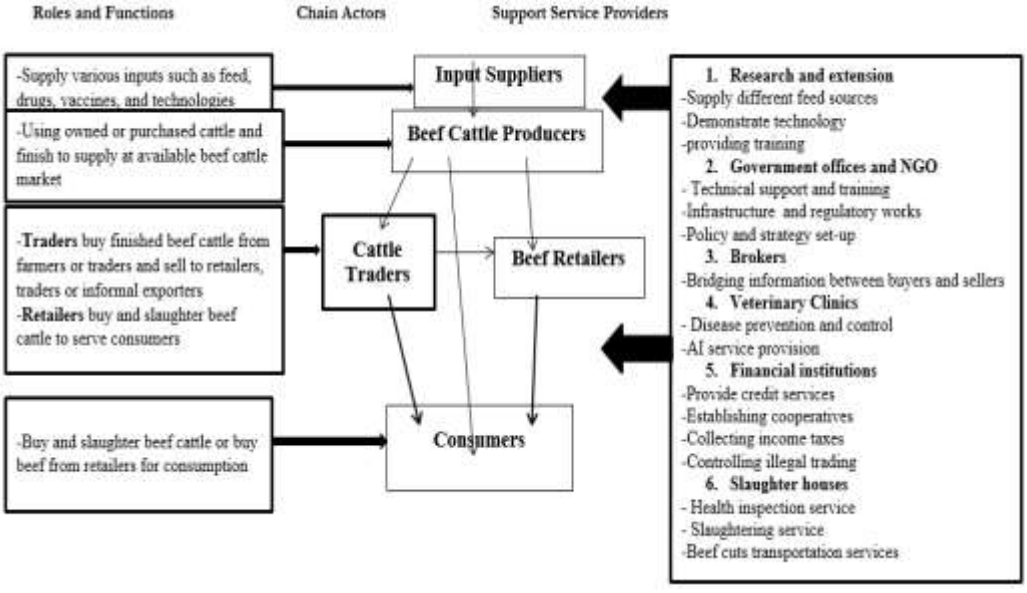

Figure 1. Beef cattle value chain map in Sodo Zuria and Misrak Bedwacho districts.

3.3.2. Roles and functions of farmers in the value chain

Beef cattle producers are farmers who fatten cattle of different sex and age for a limited period of time (usually 3-6 months) and finally supply to the local market. It is clear that farmers in rural areas especially in highland parts of the country in general, and in the study areas in particular perform mixed crop-livestock farming system (ADP-LMD, 2013; CSA, 2014). The main roles and functions of beef cattle producers are fattening cattle through utilizing available feed resources mostly in semi-intensive type of feeding system and supply them to the nearest cattle market to generate income when the animals conditioned. The sources of cattle for fattening might be from own herd or could be purchased from local cattle market.

3.3.3. Roles and functions of beef cattle traders in beef cattle value chain

The role of beef cattle traders in various stage of beef cattle value chain varies. In the study areas, beef cattle traders purchase beef cattle having better body condition from the bush and sell them to other large traders or informal agents for export purpose. On the other hand, traders might sell cattle for retailers and consumers.

Table 3. Beef cattle traders buying and selling price of different sized beef cattle (N=15).

Cattle type	Average buying price (ETB)	STD	Average selling price (ETB)	STD	Gross profit (ETB)
Large-sized	11,500.00	1,635.30	12,373.33	1,553.60	873.33
Medium-sized	8,073.33	884.40	8,706.67	786.90	633.34
Small-sized	5,280.00	738.90	6,046.67	692.70	766.67

Note: ETB: is Ethiopia currency (birr); N: is number of respondents; STD: standard deviation.

Beef cattle traders buying and selling prices of different sized beef cattle are presented in Table 3. Obviously, there exists variation in buying and selling prices for different sized

beef cattle in different season of the year. To calculate the profit earned by beef cattle traders, the price of cattle based on their size was taken only from male animals because of abundant supply. Thus, based on the size of beef cattle supplied to the market, the average purchasing and selling price varies. Based on the calculation on the average buying and selling price of large, medium and small sized beef cattle, traders earned a profit of ETB 873, 633 and 767 per cattle, respectively. However, the current result is somewhat far in figure from the average profit obtained by traders reported by Harko (2015) where traders fetched on average more than one thousand ETB per cattle. The difference might be due to the market price difference between different years and seasons.

3.3.4. Roles and functions of beef retailers in the value chain

Beef retailing activities in Sodo and Shone towns are presented in Table 4. Beef retailers for this study are those traders who purchase and slaughter beef cattle to serve their customers in different forms. Thus, retailers for this study are butchery shops, hotel, and restaurant owners in Sodo and Shone towns.

Table 4. Beef retailing activities in Sodo and Shone towns (% respondents).

Parameter	Sodo town	Shone town
Most preferred beef form by customers		
Ethiopian *tibis* form	29.4	50.0
Raw beef form (Ethiopian kurti)	52.9	25.0
Stew form (we't)	17.7	25.0
Method of beef transportation from slaughtering house		
By car	100.0	0.0
By cart	0.0	100.0
Who sets the selling price per kg in beef retailing?		
Beef selling shop owner himself	100.0	33.3
Sometimes negotiating	0.0	66.7
Main problems encountered in beef retailing activity		
High taxation rate	47.0	66.7
Shortage of working capital	17.7	16.7
Lack of credit facility	11.8	16.7
Poor coordination between chain actors	23.5	0.0

Therefore, based on the information from sample respondents, consumers in Sodo town mostly preferred raw beef (53%), whereas 50% in Shone town preferred Ethiopian *tibis*. Moreover, majority of the respondents (100%) in Sodo town set beef selling price by themselves; while, 66.7% of respondents in Shone town set selling price through negotiation with customers and the rest 33.3% set by themselves. Similarly, means of beef transportation after slaughter to the retailing shop varied between Sodo and Shone towns. In Sodo town, retailers transport beef using a car charging ETB 130.00 service fee per cattle including slaughter service. However, retailers in Shone town use cart loading charging ETB 75.00 per cattle. The average selling price of beef per kg in Sodo town (ETB 130.20$\pm$17.30) is a bit higher than Shone town (ETB 115.00$\pm$9.10). Retailers in Sodo town fetch a minimum and maximum selling price of ETB 100.00 and 160.00 per kg of beef; whereas a unit price of beef at Shone town is a bit lower with a minimum and maximum of ETB 100.00 and 130.00 per kg of beef. The higher beef selling price in Sodo

town might be due to better living standard of consumers at zonal level than at district level.

3.3.5. Beef consumers and their roles in the value chain

Beef consumption habits between the two study districts vary greatly probably because of the difference in income level and purchasing power of consumers at zonal and district levels. The buying price of beef at Sodo town (ETB 144.38±7.07) is a bit higher than that in Shone town (ETB 121.43±6.63). The comparison made on spatial difference among variables between Sodo and Shone towns showed that variables such as regular consumption of beef and forms of beef most preferred by consumers varied greatly (Table 5). Among the interviewed respondents, 56.3% and 28.6% regularly take beef as a diet in Sodo and Shone towns, respectively. This figure showed that beef consumption trend in Misrak Bedwacho district is much less than Sodo Zuria district. The χ^2-test revealed that the consumption habit of beef as a regular diet is significantly different between the two towns at 5% significance level. Furthermore, the various forms of beef preferred by consumers varied between Sodo and Shone towns at 1% significance level. Raw beef is more preferred (62.5%) at Sodo town; whereas, 64.3% of consumers in Shone town prefer Ethiopia *tibis*. About 75% and 57.1% of respondents preferred to buy beef from butchery shops in Sodo and Shone towns, respectively, due to fair selling price. The rest purchased from hotels, restaurants, and group slaughter during festivities.

Table 5. Spatial difference comparison of variables between Sodo and Shone towns' consumers.

Parameter	Sodo (%)	Shone (%)	χ^2-test
Is beef a regular dietary component in a diet?			8.31**
Yes	56.3	28.6	
No	43.7	71.4	
Preferred customer to buy beef:			3.25
Butchery	75.0	57.1	
Group slaughtering	6.3	0.0	
Hotel	12.5	21.4	
Restaurant	6.3	21.4	
Most preferred forms of beef:			12.60***
Raw beef (Ethiopian *kurti*)	62.5	7.1	
Ethiopian *tibis*	25.0	64.3	
Any forms equally	6.3	14.3	
Stew form (*we't*)	6.3	14.3	

*Note: Signs *** and ** indicate the significant level at 1% and 5%, respectively;*

3.3.6. Support service providers and their roles in the value chain

In the study areas, there are various support service providers in beef cattle value chain. Among these, the following are the main ones.

1. *Brokers/middlemen*: They bridge the buyers and sellers and facilitate transaction, and in some cases they indeed provide valuable services (AGP-LMD, 2013). Similarly, brokers in the study areas act as facilitators in cattle marketing. However, the chain actors complained about brokers' unfair interference in the marketing process since they act in favor of their own advantage.

2. *Veterinary health service:* There are a number of veterinary health posts in most rural *kebeles* in the study areas, which serve the surrounding community through vaccination and treatment.

3. *Agricultural extension services:* In each rural *kebele*, there is at least one development agent having college diploma in animal science. Even though, these development agents were assigned to monitor animal production and technology adoption at farmers' level, the service is not sufficient because of various factors.

4. *Credit service providers:* According to AGP-LMD (2013), for meat and live animal business, it is very difficult to get credit for cattle feeding and domestic livestock trade since livestock are not considered as collateral by banks for making loans. In the study areas, credit provision is not available for beef cattle fattening.

5. *Slaughter service providers:* Slaughtering houses are important service providers to slaughter beef cattle to serve for retailers. The service charge per cattle varies in Sodo and Shone towns. The slaughterhouse service also include health checkup before and after slaughtering.

6. *Tax collecting authority:* the office of revenue assigned tax collectors during the marketing days in order to collect tax at individual cattle base, which varies, between market places. Tax collection is also done during the renewal of working license.

3.4. Value Addition Activities by Main Value Chain Actors

Value chain concept entails addition of values as the product progresses from input suppliers to consumers. A value chain, therefore, incorporates product transformation and value addition at each stage. At each stage, the product changes hands through chain actors, transaction costs are incurred, and generally some form of value is added. A value chain can be viewed as a set of actors and their activities, organizations and the rules governing those activities (Anandajayasekeram and Berhanu, 2009). According to Fleming (2005), value addition is the act of adding value to a product, whether you have grown the initial product or not. Therefore, value addition performed by beef cattle chain actors are described in the following manner.

1. **Beef cattle producers**: beef cattle producers purchase cattle of any age-group with poor body condition from the local market or use their own cattle and feed them properly until the final sell to the next chain actors. Here, farmers add costs for feeding, health care and labor costs, and sell animals to make profit.
2. **Beef cattle traders**: are chain actors who add value through buying and/or selling beef cattle from/to available cattle market on time. According to David *et al.* (2000), a broad definition of value addition is an economical addition of value to a product by changing its current place, time, and form characteristics to more preferred once.
3. **Slaughtering houses**: According to Anton *et al.* (2013) these service providers process the meat animal into various cuts (beef) for butcheries and hotels owners. In the study areas, Sodo and Shone towns' municipalities have established slaughtering house in their respective town in order to provide cattle slaughtering services for users including anti-partum and post-partum inspection services.

4. **Beef retailers**: they buy and slaughter cattle to serve beef to end users. The beef processed into various forms as attractive as possible to final end users. Therefore, beef retailers add values in the chain through processing beef cattle and transport the beef to selling shop, hanging it in attractive manner, then make different cuts according to the consumers' interest. There are additional spices which can be served as appetizers to serve their customers.

3.5. Benefit Share of Value Chain Actors

Determining the value-added and the market share of each actor at each stage of beef cattle value chain is crucial. Moreover, the market share of each chain actor varies depending on various factors. According to Sharif and Nunung, (2014), the sum of the added value created by each actor produces the total added value for overall supply chain. In order to calculate the costs, benefits, and value-addition at each main value chain actor, for ease of cost estimation and analysis, average sized beef cattle was considered to avoid complexity and bias.

The percentage value-added at each stage in beef cattle value chain varies (Table 6). High market share is obtained in beef retailers (65.6%) followed by beef cattle producers (20.5%) and beef cattle traders (13.9%). From the result, beef cattle producers had the least market share as compared to traders as a whole. Thus, more than seventy five percent of market share come from traders in beef cattle value chain. However, farmers incur high production cost (on average ETB 1284.49) for fattening purpose other than cattle buying price; however, beef cattle traders and retailers incurred the least on average ETB 200.00 and 382.41, respectively.

Table 6. The cost-benefit analysis across the main chain actors from average sized beef cattle.

Cost items	Farmers (ETB)	Beef cattle traders (ETB)	Beef retailers (ETB)
Cattle buying price	4437.93	6362.22	7234.48
Feed cost	1102.22	25.32	25.00
Health care cost	28.84	-	10.00
Labor cost	10.68	35.00	120.00
Transport cost	55.00	60.00	20.00
Brokers' fee	61.98	56.25	50.00
Tax fee	13.41	8.65	9.89
Slaughtering cost	-	-	98.66
Personal cost	12.36	14.78	48.86
Total variable costs	1284.49	200.00	382.41
Total costs (TC)	5722.42	6562.22	7616.89
Total revenue (TR)	6896.33	7362.50	11387.45*
Value-added (TR-TC)	1173.91	800.28	3770.56
% Market share	20.5%	13.9%	65.6%

*Note: ETB is Ethiopian birr; *is 85kg × 133.97 ETB/kg; and ETB 5744.75 is the sum total of value added by the main actors for % share calculation*

Farmers bought or use owned cattle and incur more costs to add value on cattle in terms of body weight change through proper feeding and management, however, earn less profit as compared to the traders in the study areas. Traders (commonly beef cattle traders and retailers) earn more profit within a short period of time even within a day. Unfortunately, farmers incur more human power and capital investment to produce cattle

after three or four months but earning less profit. This study is in agreement with Harko (2015) in that farmers in Wolaita areas exerted more activities to perform beef cattle fattening but earn less profit. As a principle, the benefit share of an actor in a given value chain of certain commodity should go in line with the contribution of that actor in the commodity value chain. Nevertheless, in the current study, farmers' contribution in beef cattle value chain specifically in changing a commodity form earn lesser profit as compared to other main value chain actors. This might be mainly due to the poor coordination and collaboration between and among beef cattle value chain actors as a result of weak value chain governance.

3.6. Factors Affecting the Value of Beef Cattle Supply

The value of beef cattle (dependent variable figure) was log-transformed while fitting the multiple linear regression model. Based on the result of multiple linear regression analysis, educational status of household head has positive effect on the value of beef cattle supplied to the market at 10% significance level. As a result, as the level of education of beef cattle fattener increases, the value of marketed supply of beef cattle also increases due to the fact that educated farmers better manage beef cattle and hence add more value.

Table 7. Results of regression analysis for the value of beef cattle supplied to the market.

Variable	Coefficient	Standard Error	t-value
Constant	7.434	0.355	20.94
Age of household head	0.001	0.004	0.25
Sex of household head	0.011	0.046	0.24
Educational status of household head	0.068	0.037	1.84*
Family size per household	0.018	0.010	1.80*
Livestock holding per household (TLU)	0.021	0.015	1.40
Income from other sources	0.155	0.032	4.84***
Experience in cattle fattening	0.010	0.007	1.43
Total landholding per household (ha)	0.184	0.076	2.42**
Distance from cattle market	-0.031	0.010	-3.10***
Access to extension service	0.066	0.086	0.77
Access to credit service	-0.054	0.039	-1.39

*Note: Signs *, **, and *** indicate the statistical significance level at 10%, 5% and 1% respectively.*

Moreover, income generated from other sources has positively affected the value of beef cattle supplied to the market at 1% significance level. For a unit increase in farmers' income generated from other sources, the value of beef cattle supplied to the market increases by 15.5%. This situation encourages farmers to involve in more cattle fattening at a time because of the increase in income. Similarly, family size has positively and significantly affected the dependent variable at 10% significance level. This positive relationship showed that large family size might be used as a source of labor for cattle fattening. This result is against the finding reported by Harko (2015) which showed that family size has a negative relation with the level of participation of farmers in Sodo Zuria and Offa districts of Wolaita zone. This deviation might be due to the age difference of the family members between the two studies. In addition, landholding per household showed a positive and significant effect on the value of beef cattle supplied at 5% significance level. This showed that, as farmers possess larger total landholding, the chance to fatten beef cattle increases because of ample feed resources.

On the contrary, the distance of cattle market from farmers' residence affected the value of beef cattle supplied to the market negatively and significantly at 1% significant level. A kilometer increase in cattle market from farmers' residence reduces the value of beef cattle supplied to the market by 3%. Therefore, improving market accessibility is important to benefit the rural poor.

3.7. Value Chain Governance

According to Kaplinsky and Morris, (2001), the governance of value chains arise from the requirement to set product, process, and logistic standards which then influence upstream or downstream chain actors. Generally, value chains are characterized by repetitiveness of linkage interactions among and between chain actors (Kaplinsky and Morris, 2001). However, the current study identified that the collaboration and association between and among chain actors is very weak and need immediate support to maximize beef cattle value chain. It indicates that there is very weak value chain governance along the beef cattle value chain in the study areas. Therefore, the beef value chain governance activities should be taken into consideration by the responsible bodies for the future success of the beef industry and hence equally benefiting beef value chain actors.

3.8. Challenges and Opportunities of Beef Cattle Value Chain

3.8.1. Challenges

According to the information from respondents, because of the depletion of natural resources, animal feed scarcity and skyrocketing purchasing price are the main challenges of beef cattle production nowadays. According to Carina (2013), limited supply of feed source for animals has resulted in high feed prices, which in turn led to high domestic prices and reduced competitiveness on international export markets. In addition, shortage of working capital, inconsistent flow of market information between chain actors, weak trend in providing timely support service, poor extension system, weak coordination between value chain actors and lack of qualified manpower are some of the main challenges. Moreover, presence of brokers in cattle marketing especially in Wolaita areas is a great challenge raised by chain actors. Long market chain is an important barrier for producers and inhibits them from direct benefiting through sell of their animals without involvement of brokers (Endrias and Tsedeke, 2006).

3.8.2. Opportunities

Opportunities are defined as favorable circumstances or conditions available for a given issue/activity to be considered as a good chance and thereby to upgrade that specific activity. Sample respondents pointed out various opportunities in the study areas which initiate beef cattle producers and other chain actors to exploit beef cattle source as the main stay of their life. Among these opportunities, conducive climatic condition, huge market opportunities, human population growth, and large number of cattle population are the major ones.

4. Conclusions

Based on the result, beef cattle producers, beef cattle traders, beef retailers and consumers are identified as the main value chain actors supported by various service providers in the study areas. Brokers/middlemen, veterinary clinics, abattoir, financial institutions, extension service centers, various government offices and NGOs are support service providers among others. Generally, farmers as beef cattle producers added value on beef

cattle through proper feeding and management using their own herd or by purchasing from the local market. Moreover, farmers mostly use oxen/bull for draft purpose for at least one rainy season and finish it for about three to five months and supply it to cattle market by targeting the main Ethiopian holidays. On the other hand, beef cattle traders purchased better conditioned beef cattle from producers, collectors, or other traders from available cattle market and sold it within a week or more at another market for profit making. The profit they fetch varied depending on the season of buying and selling time, the demand and supply as well as their bargaining power during marketing time. Similarly, beef retailers purchased good conditioned beef cattle from the local market either through broker or by themselves and destined the cattle to slaughter house, then the beef product would finally destined to the selling shop and served to customers in various forms.

During the value addition activities, different value chain actors incurred production costs to bring a product (beef) to the end users. For instance, farmers incurred costs for feeding, herding, for disease protection and management and the value that the farmers added was to improve the quality of the product (beef). Therefore, farmers incurred the higher cost of production to finish beef cattle before supply it to the market for selling. Unfortunately, they benefited less in terms of profit as compared to the other actors in the chain. On the contrary, beef cattle traders add value in terms of time and place utility and supply beef cattle to the next actors within a short period of time. Similarly, retailers bought beef cattle and slaughter to serve their customers to earn profit. Therefore, based on the result of the current study, beef cattle value chain actors add values at different magnitude and earn profit differently. Therefore, retailers fetched the highest profit margin as compared to the farmers and beef cattle traders.

On the other hand, the result of regression analysis confirmed that the predictors identified as factors affecting the value of beef cattle supplied to the market differently. Based on the result, independent variables such as educational level of household head, experience in cattle fattening, family size per household, income generated from other sources, and land size owned per household have positively and significantly affected the value of beef cattle supplied to the market. On the other hand, distance of cattle market from the producers' residence negatively and significantly affected the value of beef cattle supplied to the market. Therefore, the variable affecting the value of beef cattle supplied to the market negatively requires great attention in order to minimize its risk on the beef sector in the study areas. Similarly, those variables affecting the dependent variables positively and significantly are good indicators for the betterment of beef cattle value chain in the study areas. Therefore, this study forwarded appropriate recommendation for the improvement of beef cattle value chain in the study areas in particular and in the region in general.

The recommendations forwarded are as follows:

1. Capacity building concerning beef cattle value chain for concerned stakeholders is crucial.
2. Infrastructures such as road networks, watering and feeding facilities in the cattle markets are important specifically for beef cattle suppliers who brought cattle from the remote areas.
3. Government bodies should give emphasis to the market accessibility for beef cattle through organizing cooperatives in beef cattle marketing to minimize the long market chain.
4. Support service providers should give timely organized services to improve the benefit gain of farm households at the grass root level.

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12. Reproducibility of Coffee Quality Cupping Scores and Their Correlations between Exporters and Importers

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Abstract

The reproducibility of cupping scores for 30 coffee bean samples from eastern, southern and southwestern origins in Ethiopia was evaluated by comparing absolute differences within and between nine cuppers, three Ethiopia Commodity Exchange (ECX) cupping centers (Jimma, Awassa, Dire Dawa) and three coffee origins. Additionally, the correlation between cupping scores of an exporter (ECX) and an importer (EFICO Agency SA) was evaluated based on 70 coffee bean samples from five different origins. Differences in ECX cupping scores variability were generally observed for all studied quality attributes. Variability was higher between than within cuppers. Furthermore, particular high variable scores were observed for Dire Dawa cupping center and for some attributes of the southwestern coffee origin. However, the average absolute difference for total cup quality was small (ca. 3 on a 100 scale), which indicates that cupping scores by the ECX are sufficiently reproducible to allow reliable coffee quality grading. However, no correlation was observed between cupping scores of the exporter and importer, which indicates lack of interchangeability between grading data produced by both actors.

Keywords: Cupper; coffee origin; coffee quality attribute; cupping score variability; absolute difference; correlation.

1. Introduction

Coffee is a globally traded agricultural commodity and its value is based on a set of quality parameters that requires reliable data (Lundy *et al.*, 2012). In business-to-business coffee trading, at least two quality tests with different objectives are carried out: exporters assess coffee quality for importers, who in turn make their own assessment for end users (e.g., coffee roasters). The quality of coffee is determined by both physical and sensory analyses. The most commonly used method to assess the cup quality of coffee is sensory analysis, in which a panel of trained, specialized "cuppers" evaluates coffee quality using either a table with scoring values (scoring method) or a sensory lexicon (descriptive method). A sensory method is thought to be fairly subjective and generally less replicable and consistent than physically based measurements (Songer, 2012; Stone & Sidel, 2004). Though a certain degree of consistency can be attained using the sensory method through training and adoption of standardized cupping protocols, individual variability among cuppers is not always addressed. Inter-individual differences in sensory sensitivity and perception exist among panelists due to genetic factors, education, past experiences, food habits, smoking habit, health, age, and cultural and religious patterns (Barborová *et al.*, 2013; Mojet *et al.*, 2001; Murray *et al.*, 2001; Vaclavik & Christian, 2008; Romano *et al.*,

2014). Studies have confirmed this by showing inconsistency among cuppers (Oberthür *et al.*, 2011; Romano *et al.*, 2014). However, despite its constraints (e.g., inconsistency, cost, time-consumption) and the attempts to substitute it with other methods (e.g., NIR spectroscopy, NMR spectroscopy) (Barbin *et al.*, 2014; Lindinger *et al.*, 2008; Ribeiro *et al.*, 2011), the sensory method is still the ultimate test to determine the cup quality of coffee.

Coffee production in Ethiopia, one of the world's largest coffee exporting countries, is concentrated in four major coffee producing regions (i.e., origins): western, southwestern, southern and eastern Ethiopia. The quality of coffee from each region is assessed and graded by cupping centers of the Ethiopia Commodity Exchange (ECX), which have been established in each of the four major coffee growing regions. Hence, each center grades the quality of coffee produced in its specific locality. This may result in cuppers who are particularly adapted to the taste of a specific coffee origin (i.e., their local coffee), which could in turn affect the reproducibility of cupping scores between cupping centers as well as between coffee origins. On the other hand, importers assess the quality of coffees from diverse origins, which can lead to broader taste preferences for importers compared to exporters. This may affect the relationship between cupping scores of exporters and importers. To the best of our knowledge, data on the reproducibility of cupping scores between individual cuppers or between cupping centers in coffee exporting countries is very scarce. Also rare is information on the relationship between cupping scores given by exporters versus importers.

In this study, we investigated the variability in sensory cup quality scorings of Ethiopian coffee for a specific cupper, between individual cuppers, and for different cupping centers and coffee origins. We also studied the correlation between cupping scores of an exporter (ECX, Ethiopia) and an importer (EFICO Agency SA, Belgium). The specific objectives of the study were (1) to assess the reproducibility of cupping scores and the influence of preliminary quality assessment errors on whether a sample qualifies for specialty coffee evaluation in Ethiopia, and (2) to determine the relationship between the cup scoring data of the two main actors (exporter and importer) in the international coffee trade.

2. Materials and Methods

2.1. Description of Sampling Regions

Coffee samples originated from four major and one minor coffee growing regions, namely eastern, southern, southwestern and western Ethiopia, and northwestern Ethiopia, respectively. These coffee growing regions have different agroecology and coffee production systems.

The coffee growing areas in southwestern Ethiopia have a hot and humid rainforest climate with high and reliable unimodal rainfall as well as moderately acidic soils, which are mainly red or brownish ferralsols (Gole, 2003; Schmitt, 2006; Senbeta & Denich, 2006). Semi-forest coffee is the dominant coffee production system in this region (Schmitt, 2006), prevailing over the other major coffee production systems in Ethiopia: forest, garden and plantation coffee. The region produces both washed and unwashed coffee, with unwashed constituting a larger share of the total production. The coffee is designated as Limmu, Jimma and Kaffa coffee for marketing purposes (Boot, 2011).

Southern Ethiopia contains two major coffee growing areas (Sidama and Gedo). Different agro-climatic zones and microclimates exist in the region, but the *Woina-Dega* (moist to sub-humid warm subtropical climate) regions, situated between 1500-2300 m a.s.l., are the most important in terms of agriculture and coffee production (Abebe, 2005;

Boot, 2011). These regions generally have bimodal rainfall and various types of soils; e.g., eutric nitisols, pellic vertisols, orthic acrisols, chromic luvisols and eutric fluvisols (Abebe, 2005; Assefa & Bork, 2014). Coffee in this region is predominantly produced under a garden system and processed as both washed and unwashed, with a higher share of the washed coffee. It is designated as Sidama and Yirgacheffe coffee for marketing purposes (Boot, 2011).

The eastern coffee growing region is subdivided into four smaller areas: East Hararghe, West Hararghe, Bale and Arsi. The region has a dryer and warmer climate than the western or southern Ethiopia and experiences bimodal rainfall (Boot, 2011). The green coffee beans of this region, produced predominantly under a garden system, are exclusively unwashed and are known as Harar coffee (Boot, 2011).

The western region contains two major coffee areas (West and Kelem Wellega), which have an agroecology almost identical to southwestern Ethiopia. According to Labouisse *et al.*, (2008), the coffee in this region is predominately produced under a garden coffee production system. However, our recent observations as well as interviews with experts show instead that it is produced mainly under a semi-forest production system. Until recently, western Ethiopian coffee was processed as unwashed coffee and designated as Nekemt coffee for marketing purposes (Boot, 2011).

The main coffee growing area in the northwestern Ethiopia is concentrated in the Metekel, Agew Awi and West Gojam Administrative Zones. It has less annual rainfall than the wet southwestern, western and southern regions. In this region, coffee production units are very small and mainly use a garden system (Labouisse *et al.*, 2008).

2.2. Description of ECX Cupping Centers and EFICO

Excluding the cupping centers in the capital, which test and grade the quality of coffee for international markets, there are currently eight cupping centers in Ethiopia: Awassa, Dilla and Sodo in the south; Jimma, Bedelle and Bonga in the southwest; Gimbi in the west; and Dire Dawa in the east. Including the supervisor, each cupping center has 4 or 5 Q-certified cuppers who test and grade the quality of the coffee produced in their respective region. That information is then used by suppliers who deliver the coffee to a national market or exporters.

The samples used for reproducibility testing were collected from and tested in the Jimma, Awassa and Dire Dawa cupping centers, which are established within the city of Jimma (7°40'N, 36°50'E, 1780 m a.s.l.), Awassa (7°30'N, 38°28'E, 1708 m a.s.l.) and Dire Dawa (9°36'N, 41°52'E, 1204 m a.s.l.), respectively. Three coffee producing regions (origins) were considered: the Jimma cupping center mainly receives coffee from the Jimma Zone and its surrounding areas (southwestern Ethiopia), the Awassa cupping center receives coffee from Sidama and neighboring zones (southern Ethiopia), and the Dire Dawa cupping center receives coffee from the West and East Hararghe Zones and parts of the Arsi and Bale Zones (Eastern Ethiopia).

The EFICO Agency SA, established in 1926, is a green coffee and cocoa trading agency providing services to the European coffee and cocoa sector. It sources its commodities from 36 different countries around the world and is one of the importers of Ethiopian coffee to Europe. The cupping lab of EFICO tastes all samples that arrive in the warehouse based on physical and sensory aspects following standardized procedures (EFICO, 2013).

2.3. Research Design and Cupping Procedure

For the reproducibility test, 10 samples of unwashed coffee (each about 3 kg) were randomly collected from the loads of 10 trucks (1 sample per truck) arriving at the warehouse of each of the three selected cupping centers (i.e., Jimma, southwestern Ethiopia; Awassa, southern Ethiopia; and Dire Dawa, eastern Ethiopia), giving a total of 30 samples. Each coffee sample was cupped on two consecutive days by three Q-certified cuppers in each of the three cupping centers (i.e., a total of 9 cuppers). Cup quality attributes and total cup value were evaluated following the ECX protocols for preliminary quality assessment. This resulted in a total of 18 cup tests for each coffee sample (3 centers x 3 cuppers x 2 days), 180 cup tests for each coffee origin (10 samples x 3 centers x 3 cuppers x 2 days), 180 cup tests for each cupping center (30 samples x 3 cuppers x 2 days), and 60 cup tests for each cupper (30 samples x 2 days).

Based on the ECX cupping procedure (ECX, 2011), about 350 g of green beans per sample and per cupping session were evaluated for raw bean quality attributes (primary defects, secondary defects and odor). Primary defects include full black, full sour, fungus attacked and insect damaged beans as well as the presence of foreign matter, whereas secondary defects include partial black, partial sour, slightly insect damaged, floater, immature, withered, shell, foxy, under-dried, over-dried, mixed-dried, stinker, faded, coated, light and starved beans. The scale of scoring for odor ranged from 0 to 10 and for primary and secondary defects from 0 to 15 each, which gives a subtotal scoring value of maximum 40. Next, 150 g of green beans was roasted for a medium roast (for about 8 to 12 minutes by a heated roaster at about 250°C), and the air-cooled sample was ground to a size of <20 mesh. Then, 13.75 g of coffee powder was added into five cups and about 250 ml of clean and odor free hot water (about 93°C) was poured on the coffee powder. The contents of all cups were then stirred until the coffee powder was completely infused with hot water. Finally, each cup was tasted for acidity, body, cleanness and flavor, and the tasting score of each attribute was recorded. The scale of scoring for each cup quality attribute ranged from 0 to 15, which gives a subtotal scoring of maximum 60. The sum of both subtotals gives a total cup value of maximum 100, which is then used to grade the final quality of the coffee samples and differentiate between potential specialty and commercial coffees. If this value is greater than or equal to 75, the coffee sample is further assessed in order to determine whether it can be designated as specialty coffee.

For the correlation analyses between ECX and EFICO cup test results, additional samples of natural sundried (unwashed) coffee (n = 70, each about 1 kg) were collected from 24 districts (3 samples from three different farms per district), located in five coffee growing regions of Ethiopia: southwest (n = 33), west (n = 9), south (n = 3), east (n = 13) and northwest (n = 12). Each sample was cupped by three Q-certified cuppers in the Jimma ECX cupping center (Ethiopia) and by five internally trained cuppers at the EFICO Agency SA (Antwerp, Belgium).

Evaluation of samples at the ECX was performed as previously described for the reproducibility tests; i.e., following the preliminary quality assessment procedure of the ECX (national standard) (ECX, 2011). At EFICO, samples were cupped for eight cup quality attributes (aroma, flavor, aftertaste, acidity, body, balance, fruity, perfume), following the cupping protocols of the Specialty Coffee Association of America (international standard) (SCAA, 2013). Each cup quality attribute at EFICO was scored on a scale of 0 to 10. For each sample, the scores of the eight attributes were averaged to arrive at an overall quality of the sample and compared with the total cup value of ECX.

2.4. Statistical Analysis

The analysis makes use of both the 95% reference range and the 95% confidence interval. The 95% reference range is based on the standard deviation (SD) and refers to the variation of individual samples, whereas the 95% confidence interval is based on the standard error (SE) and refers to the variability of the mean of individual samples (Whitley & Ball, 2002).

First, the within cupper variation was evaluated by calculating the absolute difference between the two assessments of the same sample by the same cupper. The mean absolute difference, together with the one-sided 95% reference range, was calculated. This one-sided 95% reference range goes from 0 to the mean + 1.645SD and contains 95% of the absolute differences between two assessments of the same sample by the same cupper. Second, the between cupper variation was evaluated by calculating the absolute difference between two assessments of the same sample by two different cuppers. The mean absolute difference, together with the one-sided 95% reference range, was calculated in a similar way as before. In this case, the one-sided 95% reference range contains 95% of the absolute differences between two assessments of the same sample by two different cuppers.

The absolute deviations within and between cuppers were compared by t-tests at the 5% significance level in order to test whether two assessments of the same coffee sample differ more when the two assessments are performed by two different cuppers or by the same cupper. Third, we investigated whether the between cupper variability was influenced by either the cupping center or the origin of the coffee sample by fitting a mixed model in which the absolute difference was taken as a response variable, the cupper as a random effect and the cupping center and coffee origin as the categorical fixed effects. F-tests at the 5% significance level were used to test differences between cupping centers and coffee origins. Here, the mean absolute difference, together with the one-sided 95% confidence interval was calculated. This one-sided 95% confidence interval goes from 0 to the mean + 1.645SE; the true (population) absolute difference is located in this confidence interval with 95% probability. Fourth, the correlation between cupping scores made by ECX (exporter) and EFICO (importer) was investigated by calculating Kendall's tau between the total cup value of ECX and EFICO. All analyses were performed with SAS Version 9.4.

3. Results

3.1. Cupping Score Variability within Cuppers and between Cuppers

The mean absolute differences and the one-sided 95% reference ranges for cup quality parameters and total cup value (Total CV), showing the variability within and between cuppers, are presented in Figure 1. The between cupper variation was substantially larger ($P < 0.05$) than the within cupper variation for each variable. Especially for cleanness and Total CV, the 95% reference ranges for the absolute differences between the cuppers' scores rose up to 6.7 and 7.1, respectively, whereas that of the within cuppers were 3.7 for cleanness and 4.5 for Total CV. Despite these wide reference ranges, the average absolute differences for each attribute were low. For example, the average absolute differences between cuppers were less than 1.8 for each cup quality attribute scored and less than 3.0 for Total CV.

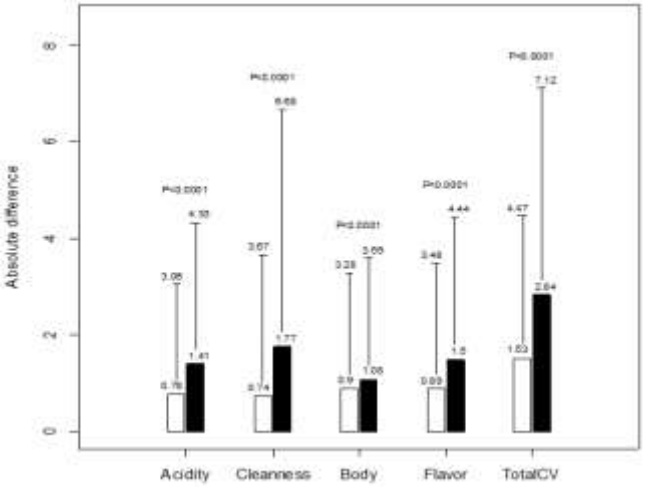

Figure 1. Mean absolute differences of cupping scores within cuppers (white box) and between cuppers (black box) for acidity, cleanness, body, flavor and total cup value (Total CV).

Note: Numbers on the top of the boxes denote the average absolute differences, error bars denote the 95% reference ranges (= mean + 1.645SD), numbers on the top of error bars denote the upper limit of the 95% reference ranges, and p-values correspond to the hypothesis that the variation within and between cuppers is the same.

3.2. Cupping Score Variability between Cupping Centers

The average absolute differences in cupping scores between cuppers within each cupping center, together with their 95% confidence intervals, are given in Figure 2. The cupping score variability of the Dire Dawa cupping center was significantly higher ($P < 0.05$) than that of both the Jimma and Awassa centers for all tested attributes, except flavor. The Jimma and Awassa cupping centers performed similarly for all tested attributes, with average absolute differences that were less than 1 for each cup quality attribute scored and ca. 1.5 for Total CV (Figure 2).

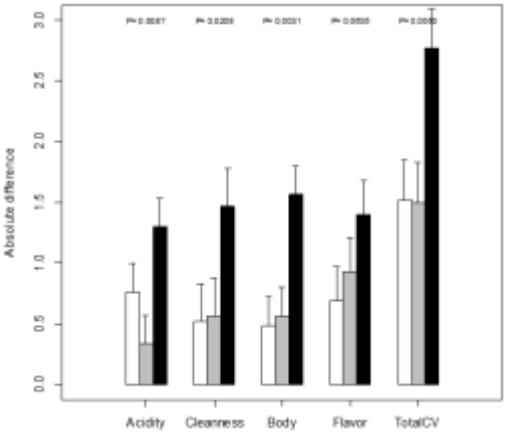

Figure 2. Mean absolute differences of cupping scores between cuppers in three different cupping centers.

Note: Jimma (white box); Hawassa (gray box) and Dire Dawa (black box) for acidity, cleanness, body, flavor and total cup value (Total CV). The top of the boxes denote the average absolute differences, error bars denote the 95% confidence intervals (= mean + 1.645SE) and p-values correspond to the hypothesis that there is no difference in variation between cupping centers.

3.3. Cupping Score Variability between Coffee Origins

As indicated in Figure 3, there was also a significant difference (P <0.05) in cupping score variability between different coffee origins for all attributes, except body. However, the variability between coffee origins was inconsistent; i.e., coffee origin did not affect all attributes in the same way. For example, the eastern Ethiopian coffee gave a significantly higher cupping score variability for flavor, but showed lower variability for Total CV compared to the coffees of southern and southwestern origins. On the other hand, the southwestern Ethiopian coffee showed a significantly higher variability for acidity and cleanness compared to the other origins. The eastern and southern origins had similar cupping score variability for acidity and cleanness, while the southern and southwestern origins showed similar variability for flavor and Total CV.

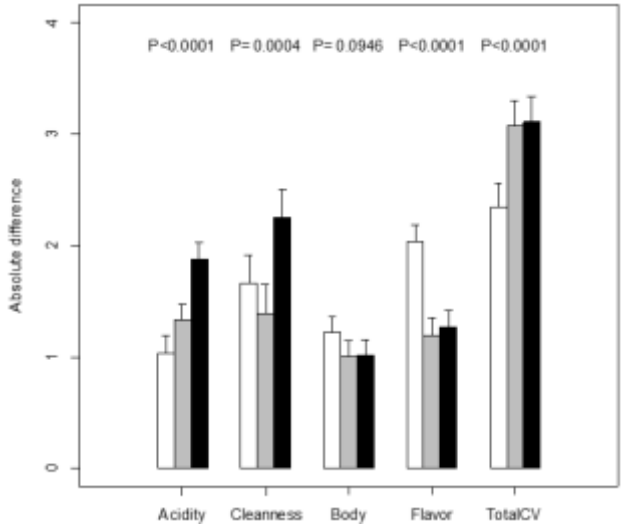

Figure 3. Mean absolute differences of cupping scores between three different coffee origins.

Note: Eastern coffee (white box); southern coffee (gray box) and southwestern coffee (black box) for acidity, cleanness, body, flavor and total cup value (Total CV). The top of the boxes denote the average absolute differences, error bars denote the 95% confidence intervals (= mean + 1.645SE) and p-values correspond to the hypothesis that there is no difference in variation between coffee origins.

3.4. Correlation between Cupping Scores of Exporter and Importer

The Kendall's tau correlation coefficient between the ECX (exporter) and EFICO (importer) cupping scores was -0.04925 and was not significantly different from zero (P >0.05). Hence, exporter and importer cupping scores did not correlate. This means that a sample that received a high score by the ECX (exporter) did not necessarily receive a high score by EFICO (importer) and vice versa.

4. Discussions

To date, coffee quality is mainly determined using a sensory method, which is thought to be fairly subjective and considered less reproducible and reliable than a physically based method. For the "cupping" method used here, all average absolute differences for Total CV were reasonably small (ca. 1.5-3.0) (Figures 1-3). Keeping in mind that total cup value was scored on a 0-100 scale, this shows that the reproducibility of Total CV scores is fairly high. In practice these scoring biases are not likely high enough to substantially

affect quality grading since each grade covers a wider range of points (10-15) than is attributable to variability of Total CV scores (i.e., a Total CV of 85-100, 75-84 and 63-74 qualifies for grades 1, 2 and 3, respectively). In contrast to the reasonably small differences in Total CV, average differences as large as 2 points for individual coffee quality attributes, scored on a 0-15 scale, seems high. However, this is explained by the fact that the ECX divides this 0-15 scale into six sub-classes that differ by three points (i.e., 15, 12, 9, 6, 3 and 0) (ECX, 2011). In any case, for both Total CV as well as individual quality attributes, some notable differences occurred between cuppers, cupping centers and coffee origins. This is not surprising, given that sensory analysis is affected by various factors, which will be discussed further below.

Considering the fact that inter-individual variations are often greater than that of intra-individual, the lower reproducibility between cuppers compared to within cuppers in this study (Figure 1) is not unexpected. This inconsistency between cuppers is supported by studies testing the consistency of professional cuppers in other countries. For example, only one in five cuppers showed an acceptable cupping consistency in Colombia (Oberthür *et al.*, 2011). Similarly, a lack of agreement among cuppers with respect to tasting notes on aroma and flavor was reported by Di Donfrancesco *et al.* (2014). These inconsistencies could be due to psychological, physiological and/or external factors as well as natural variation between cuppers in terms of sensitivity to and perception of different tastes (Barborová *et al.*, 2013; Vaclavik & Christian, 2008). Other reasons could be related to education, experience, food habits, health, age, and/or social, cultural and religious practices of individual cuppers (Barborová *et al.*, 2013; Mojet *et al.*, 2001; Murray *et al.*, 2001; Vaclavik & Christian, 2008; Romano *et al.*, 2014; Seo *et al.*, 2009). Factors affecting the daily sensory sensitivity of individuals (e.g., climate) may also play a role (Barborová *et al.*, 2013; Murray *et al.*, 2001; Vaclavik & Christian, 2008). Improved consistency between cuppers could be attained by improving tasting conditions, providing continuous training and strictly following cupping guidelines. In addition to these methods, the effect of variability between cuppers on cup quality data could also be reduced by increasing the number of cuppers, essentially decreasing the standard error of the mean cupping score.

The inconsistency that was observed between cuppers in our study can also be partly attributed to the high variability of particular cupping centers and of particular coffee origins. For instance, the Dire Dawa cupping center showed a lower reproducibility than the Jimma and Awassa centers for all attributes (Figure 2). This suggests that the reliability of cupping scores in Dire Dawa could be improved; e.g., via experience sharing with other centers. However, this variability may be due in part to differences in the cuppers' tasting experience (adaptation), or could result from differences in sensitivity to and/or perception of the taste of a specific coffee origin (Vaclavik & Christian 2008). Coffee origin, in fact, also affected the reproducibility of cupping scores: southwestern coffee showed a lower reproducibility for acidity, cleanness and Total CV, while eastern coffee had less reproducible flavor scores. Our sampling regions vary in agroecology and coffee management (Abebe, 2005; Boot, 2011; Gole, 2003; Senbeta & Denich, 2006; Wiersum, 2010), which may produce a *terroir* effect on cup taste and quality for the three origins of coffee (Collet *et al.*, 2012; Läderach *et al.*, 2012), as it has been previously reported in various countries for coffee (Avelino *et al.*, 2005; Barbosa *et al.*, 2012; Decazy *et al.*, 2003; Oberthür *et al.*, 2011; Teuber, 2009) and other products (e.g., wine) (Fischer *et al.*, 1999; Styger *et al.*, 2011; Vaudour *et al.*, 2015). This effect may in turn lead cuppers to become adapted to the taste of a specific coffee origin and, given that cuppers predominantly taste coffee originating in their own region, this adaptation would clearly vary between cupping centers (Decazy *et al.*, 2003).

Overall, cupping scores for body were more reproducible between cuppers than the scores for other attributes (Figure 1). This may be related to the fact that some quality attributes of coffee can be affected by environmental conditions, which can influence the preferences of tasters. For example, Avelino *et al.* (2005) and Oberthür *et al.* (2011) found that differences in a plantation's slope, climatic conditions and altitudinal characteristics influence the acidity and flavor profile of coffee. As a result, some quality attributes, like body, may not be very variable in different environments and can be more consistently detected by tasters than others, such as acidity, cleanness and flavor (Figure 3).

The absence of correlation between the cupping scores by the ECX and EFICO was unexpected. A lack of interchangeability of cupping scores between exporters and importers may reduce trust between both actors and make transactions along the value chain more costly and difficult to manage. Differences between an exporter and an importer in cupping scores may be attributed to cupping conditions and cupping procedures and standards (e.g., national vs. international) as well as the education, prior taste experiences, taste preferences and/or socio-cultural patterns of the cuppers (Barborová *et al.*, 2013; Romano *et al.*, 2014; Vaclavik & Christian, 2008). For instance, due to their experience in cupping of coffees from diverse origins and hence broad taste preferences, cuppers of an importer may give different cupping scores for a specific coffee compared to an exporter. A study by Di Donfrancesco *et al.* (2014) supported this idea, when the authors reported a lack of agreement on terminology used to describe cup quality of coffee samples between Q-certified cuppers from the Colombian coffee industry and trained descriptive sensory panelists from the Sensory Analysis Center at Kansas State University. As the role of cup tests is to generate quality data that can be used for coffee price setting and trading, our results show a need to improve consistency between cupping scores of the ECX and EFICO and suggests that therefore there is likely also a wider reaching need for a more standardized scoring between importers and exporters. This can be achieved by developing (1) suitable and similar cupping conditions (e.g., lab setting up), (2) universal cupping procedures and standards, (3) common training and experience sharing programs (e.g., calibration of judges), and (4) quality control or proficiency testing programs.

5. Conclusions

Sensory quality scoring of coffee by the ECX in Ethiopia is affected to varying degrees by intra-cupper variability as well as variability between cuppers, cupping centers and coffee origins; there was no correlation between cupping scores of the tested exporter and importer. Despite these different effects, the average variability of cupping scores for total cup value was consistently low (i.e., ≤3), indicating an acceptable reproducibility of sensory coffee quality analysis by the ECX in Ethiopia. Variability between cuppers was larger than within cuppers, with the Dire Dawa cupping center, the southwestern Ethiopian coffee and some individual cup quality attributes (particularly cup cleanness) contributing more to the overall variability in cupping scores than other factors. Overall, we conclude that cupping score variability observed in cupping scores does not affect the overall coffee quality grade, including the threshold grade (i.e., a Total CV ≥75) that allows whether a sample qualifies for additional testing for the specialty coffee grading designation. However, regular proficiency tests would be advisable in order to ensure that the quality and reproducibility of ECX sensory analyses are maintained. In contrast, the absence of correlation between ECX (an exporter) and EFICO (an importer) cupping scores shows a lack of exchangeability between quality grading data produced by these two actors. To avoid such discrepancies, we suggest implementing suitable and similar

cupping conditions, universal standard cupping procedures, common training and experience sharing programs, and quality control systems.

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13. Prevalence of Aflatoxin Contamination in Groundnut (Arachis hypogaea L.) along the Value Chain Actors in Different Agro-Ecological Zones of Eastern Ethiopia

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Abstract

Aflatoxins are common contaminants in groundnut and pose considerable risk to human health and have significant economic implication. Although, aflatoxin contamination of groundnut could occur in the field, in storage and during marketing, the level of contamination may vary along the value chain. The objective of this study was to determine level of aflatoxin concentration in groundnut samples along the value chain in Babile, Fedis and Gursum districts of Eastern Ethiopia. A total of 45 groundnut samples from farmers' fields; 45 from farmers' stores; 30 from whole sellers, and 30 from open air vendors were collected and analyzed for aflatoxin contamination in an ELISA test. Overall, from the total 150 samples, 91 samples were positive and 59 samples were negative. The level of aflatoxin contamination significantly varies along the value chain in all the three districts. Percent prevalence of total aflatoxin concentration from the positive samples, 85% were above 10 ppb and 15% were less than 10 ppb at farmers' fields at Fedis district, indicating heavy contamination of groundnut by aflatoxin beyond the maximum tolerable level by the CODEX (10 ppb). Moisture contents were positively correlated ($r=0.956$) and significant ($p\leq0.05$) with aflatoxin levels. The current result suggests that application of pre-harvest management practices of aflatoxin contamination at farmers' fields for high quality maintenance in the groundnut value chain and averting human and animal health risks are necessary.

Keywords: Aflatoxin; Ethiopia; groundnut; prevalence; value chain actors.

1. Introduction

Groundnut (*Arachis hypogaea* L.) is a multipurpose cash crop for domestic markets as well as for foreign trade in several developing and developed countries. In Ethiopia, groundnut has a huge potential as a cash crop to improve livelihoods of farmers and traders. Developing countries account for approximately 95% of world groundnut production, but are unable to sell large quantities of groundnut on the international market because of mycotoxin contamination (FAO, 2002). Infection of groundnut seed by certain strains of *Aspergillus flavus* Link ex Fries and *Aspergillus parasiticus* Speare can

result in contamination of the seed and groundnut by-products with aflatoxins, which are toxic fungal secondary metabolites (Waliyar *et al*., 2006).

Aflatoxin contamination of agricultural commodities has significant economic implication for the agricultural industry worldwide (Richard and Payne, 2003). For instance, aflatoxin contamination cost more than US$100 million per year to US producers (Coulibaly *et al*., 2008) and more than $750 million to Africa's producers (Cardwell *et al.* 2004). Moreover, aflatoxin contamination of groundnut prevents groundnut producers in Africa from accessing bigger western markets, increases dependency on foreign food aid, stifles economic opportunities, and adversely affects consumer health. In Ethiopia, groundnut market is declining and export of the crop has come to a standstill due to aflatoxin contamination and difficulty of meeting tolerance limits by importers and food processors. A food processing company imported groundnuts from India while groundnut producers in the country could not find market to sell their product.

In addition to the economic implication, aflatoxins pose considerable risk to human and livestock health. Aflatoxins are acutely toxic, immunosuppressive, mutagenic, teratogenic and carcinogenic compounds targeting mainly the liver for toxicity and carcinogenicity (Peraica *et al*., 1999). Outbreaks of acute aflatoxicosis from contaminated groundnut in humans have been documented in Kenya, India, Malaysia and Thailand (CAST, 2003). One of the first major documented reports of aflatoxins in humans occurred in 150 villages of western India in 1974 where 397 persons were affected and 108 persons died (Krishnamachari *et al*., 1975).

Aflatoxin contamination is both a pre-harvest and postharvest problem. It could occur during all stages along the groundnut value chain (Dohlman, 2003). In Ethiopia, information on aflatoxin contamination of groundnut is scanty, and confined to limited market samples. Earlier studies reported that the level of aflatoxin in groundnut seed is 34.7μg/kg (Bisrat and Gebre, 1981), between 5 - 250 μg/kg (Amare *et al.,* 1995), and 15 - 11865 μg/kg (Alemayehu *et al.,* 2012). The aforementioned reports were based on market samples and did not address the entire groundnut value chain especially the situation at harvest. The present study was initiated to address the entire groundnut value chain covering major nodes from production through storage to consumption (marketing), since they could support decisions on targeting major points of aflatoxin contamination. The objective of the study was to determine prevalence of aflatoxin contamination of groundnut and its correlation with moisture contents along the value chain actors in different agro-ecological zones of Eastern Ethiopia.

2. Materials and Methods

2.1. Description of the Study Areas

The study dealt with field work (field survey, groundnut sampling, and groundnut varietal resistance evaluation) and laboratory characterization. The field work was conducted in major groundnut growing areas (Babile, Gursum and Fedis Districts) of East Hararghe Zone, Oromia Regional State, eastern Ethiopia (Figure 1) in 2014 crop season. The areas were selected purposively as they represent the bulk of groundnut production in Ethiopia (Alemaw and Alemayehu, 1991). These areas have high potentials for rain-fed groundnut production nationally. The agro-climatic range of the Zone includes lowland (*kolla*, 30-40%), midland (*weyna dega*, 35-45%) and highland areas (*dega*, 15-20%). In terms of altitudes, Babile is from 1401 to 1483 m.a.s.l, Fedis is 1501 to 1899 m.a.s.l., and Gursum is from 1200 to 2950 m.a.s.l.; and the geographical position of the study area is located between 09°02'52"N and 09°19'11"N latitude and between 42°06'03" E and 42°27'02" E longitude.

There are two (bimodal) rainy seasons in the Zone, the small rainy season (*belg* that extends from mid-February to mid-May) and the main season (*meher* that extends from mid-June to mid-September). Annual rainfall averages range from below 700 mm for the lower *kolla* to nearly 1,200 mm for the higher elevations of *weyna dega* and *dega* agro-climatic zones (Agriculture Office of East Hararghe Zone, 2011).

Based on the three years meteorological data of Babile District, the area has mean annual rainfall range between 500-975 mm with much variation among years and with mean annual maximum and minimum daily temperatures of 28.27 and 14.18 ^{o}C, respectively. The average rainfall of Fedis area ranges from 650-1000 mm per year and with mean annual maximum and minimum daily temperatures of 26 and 14 ^{o}C, respectively. The average rainfall of Gursum area ranges from 650-1050 mm per year and with mean annual maximum and minimum daily temperatures of 24 and 13 ^{o}C, respectively. Groundnut, sorghum, maize, and haricot beans were the major crops grown in the areas during the study period. The major cropping systems of the areas were monocropping of groundnut (in Gursum and Babile), legume-legume rotation, and legume-cereal rotation and intercropping with cereals (in Fedis) (Agriculture Office of East Hararghe Zone, 2011).

The major soil types in the area were Leptosols, Lithosols, Regosols, Cambisols, Luvisols and Arenosols with clay loam, loam, sandy loam to loamy sand textural class (Ayele, 2010).

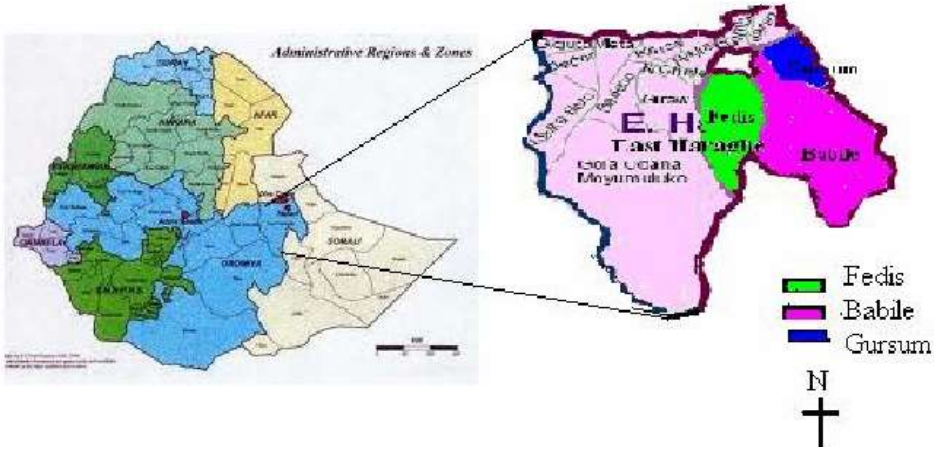

Figure 1. Location map of the study areas of Babile, Fedis and Gursum.

2.2. Description of Groundnut Value Chain in Eastern Ethiopia

The groundnut value chain in Eastern Ethiopia comprised farmers, and traders (wholesalers and retailers); rural, urban and semi-urban markets, and consumers (Figure 2). The chain started with the farmers who either consume their produce or sell it locally at markets to rural retailers or local "assemblers"-middlemen who collected and transported groundnuts to larger wholesalers. Consumers were not included in the sampling since groundnuts were usually purchased in small quantities and consumed immediately.

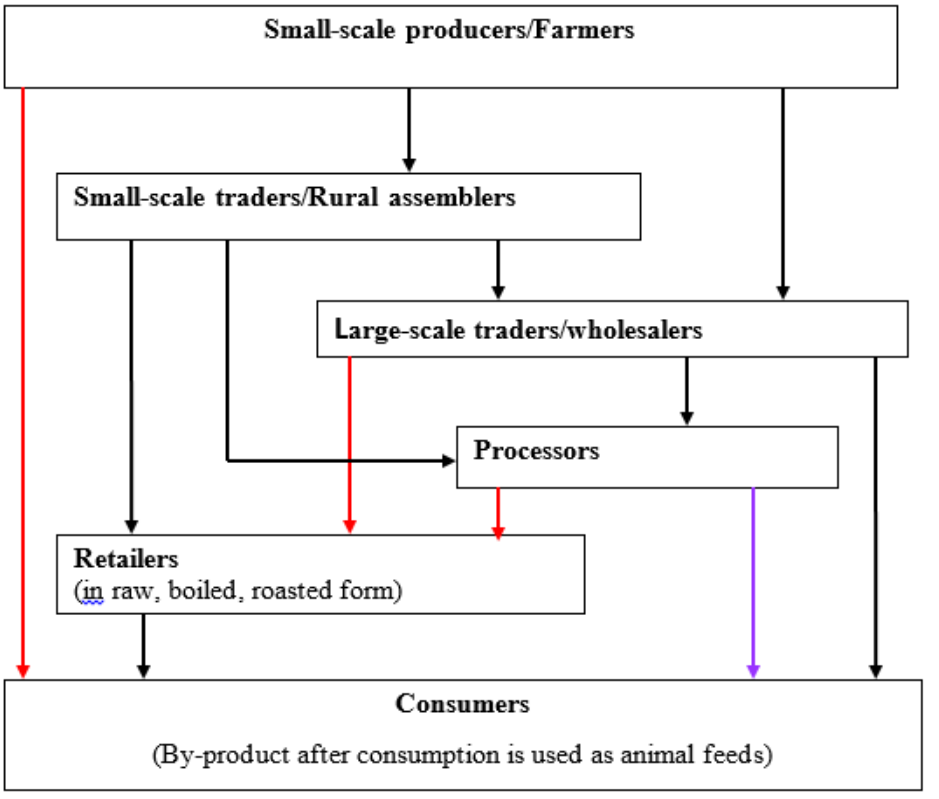

Figure 2. Flowchart of groundnut value chain and marketing channels process.

2.3. Sampling

Samples were collected along the groundnut value chain in the three districts. Accordingly, samples were randomly drawn from farmers' fields at harvest, from farmers' storage, and from traders (both wholesalers and retailers as well as from rural and urban markets). A total of 150 samples were collected as described below.

Samples were 1 kg each comprising five sub-samples drawn from different parts of the groundnut lot (composite samples). The samples were placed in cloth bags to allow air circulation that reduces condensation and limit fungal growth after sampling. Samples were properly labeled and relevant information on the locality, GPS coordinates, altitude, cultivar, date of sampling, date of harvest, type and duration of storage, etc. were recorded. Seed moisture content was measured at the time of sampling using electronic seed moisture meter. Samples were transported on the same day to Haramaya University and maintained at about 4 °C until laboratory analyses.

2.3.1. Sampling from farmers' fields and storage

Farmers' groundnut samples were collected from three locations representative of three agro-ecological zones (AEZs) that had been selected from the three districts, namely Babile, Fedis and Gursum districts of Eastern Ethiopia (Table 1). The AEZs were determined based on altitude, mean annual rainfall, and temperature as well as the probability of successfully growing the main crops of the Zone (Ngugi *et al.*, 2002; Alemayehu and Reynolds, 2006; Ayele, 2010). Accordingly, low-land dry moist (LLD) (Shek Hussien, Shek Abdi and Kito from Babile), mid-land moist (MLM) (Tuka kenisa,

Ido Basso1 and Ido Basso2 from Fedis), and high-land humid (HLH) (Audal, Oda Oromia and Kassa Oromia from Gursum) were selected (Table 1).

In each site groundnut samples were collected from three farmers' fields selected randomly at harvest and the same number of samples was collected 4 - 6 months later from farmers' storage. Farmers' fields that are 5-10 km apart from each other, depending on the availability of groundnut, were sampled within each locality. So far as possible, the storage samples were taken from the same groundnut lots as those used for sampling at harvest.

A total of 90 farmers' groundnut samples were collected, i.e., 45 groundnut samples (3 AEZs x 3 sites x 5 samples) were collected from farmer's fields at harvest and 45 samples were collected from farmers' storage facilities.

Table 1. Description of Groundnut Seed Sampling Site in Three Agro-ecologies of Eastern Ethiopia.

District	Name of cite	Altitude (m)	Temperature(^{O}C)	Rainfall(mm)	Cropping sys	Agro-ecology
Babile	Shek Hussien	1401	18-27	<900	LCR	LLD
Babile	ShekAbdi	1419	18-27	<900	LLR	LLD
Babile	Kito	1420	18-21	<900	LLR	LLD
Fedis	Tuka Kanesa	1710	18-21	900-1000	IC	MLM
Fedis	Ido Basso-1	1841	18-20	900-1000	IC	MLM
Fedis	Ido Basso-2	1899	18-20	900-1000	IC	MLM
Gursum	Audal	2201	18-20	>1000	LLR	HLH
Gursum	Oda Oromia	2509	14-18	>1000	LLR	HLH
Gursum	Kassa Oromia	2525	14-18	>1000	LLR	HLH

Note: LCR=Legume-cereal rotation, LLR=Legume rotation, IC=Intercropping with cereals, FLR=Fallow-legume rotation, LLD=Lowland dry moist, MLM=Midland moist, HLH=Highland humid.

Source: Ngugi et al., 2002; Alemayehu and Reynold, 2006; Ayele, 2010).

2.3.2. Sampling of other actors

A total of 30 samples were collected from wholesalers and retailers as well as farmers' marketing cooperatives', i.e. 10 samples from each district. These samples were collected 4 - 6 months after harvest parallel to farmers' storage samples. A total of 30 samples were collected from rural, urban, and semi-urban market places. The samples were consisting of roasted kernel samples from markets in each of the three districts.

2.4. Data Analyses

A total of 150 groundnut samples obtained from farmers' fields, farmers' stores, market retailers and vendors of the three districts (Babile, Fedis and Gursum) were used for determination of total aflatoxin concentration in groundnuts. Sample extraction for aflatoxin analysis, using Enzyme Linked Immunosorbent Assay (ELISA) test, was done following the procedure described by Waliyar *et al.* (2010) and Monyo *et al.* (2012) at ICRISAT laboratory in Malawi.

The total aflatoxin concentrations determined by the ELISA test were summarized using Microsoft Excel and calculated as ppb for each sample. Regression and correlation analysis of *A. flavus* infection and moisture contents with aflatoxin levels were done using Minttab version 17 for windows.

3. Results and Discussion

A total of 150 groundnut seed samples were collected from farmers' fields, farmers' stores, market retailers and open-air vendors along the value chain of the three districts (Babile, Fedis and Gursum) for total aflatoxin concentration analysis. All samples were analyzed at the ICRISAT laboratories in Malawi using Enzyme Linked Immuno-Sorbant Assay (ELISA). From the total 150 samples, of which 91 samples were positive and 59 samples negative? Aflatoxin concentration in the positive samples ranged from 9 ppb to 9012 ppb indicating heavy contamination of groundnut by aflatoxin beyond the maximum tolerable level by the World Health organization (WHO) (5 ppb), CODEX Alimentarius Commission (10 ppb) and the European Union (4 ppb).

Determination of total aflatoxin concentration from groundnut seeds along the value chain actors were shown in the following subsections.

3.1. Prevalence of Total Aflatoxin at Farmers' Fields

A total of 45 groundnut seed samples were collected from farmers' fields of the three districts namely Babile, Fedis and Gursum. That means 15 samples were collected from farmers' fields at Babile district, 15 samples were from farmers' fields at Fedis district and 15 samples were from farmers' fields at Gursum district. Percent of groundnut seed samples from farmers' fields with aflatoxin levels above and below 10 ppb in the three districts was shown in figure 1. With regard to the standard limits, the European Union has banned the import of groundnuts with aflatoxin content above 4 μg kg-1 whereas CODEX categorizes samples with over 10 ppb as unfit for human consumption, and all the present studies results were compared using CODEX standard limits (CODEX, 2004). Fifteen samples were tested for total aflatoxin concentration from Babile district and only 4 samples were negative while the remaining 11 samples tested positive for aflatoxins. Percent prevalence of total aflatoxin concentration from the positive samples 76% were above 10 ppb and 24% were less than 10 ppb at farmers' fields at Babile district. From Fedis district, a total of 15 groundnut samples were tested for total aflatoxin concentration and only 2 samples were tested negative while the rest 13 samples were positive. Percent prevalence of total aflatoxin concentration from the positive samples 85% were above 10 ppb and 15% were less than 10 ppb at farmers' fields at Fedis district. As compared to Babile and Fedis districts, there was less groundnut seeds contamination by aflatoxin in Gursum district, where out of 15 samples, 14 were tested positive for aflatoxin and the remaining 1 samples were negative. Percent prevalence of total aflatoxin concentration from the positive samples 45% were above 10 ppb and 55% were less than 10 ppb at farmers' fields at Gursum district. These results were obtained because of higher seeds infection by *Aspergillus* species and high moisture contents of groundnut seeds in farmers' fields (Ephrem Guchi *et al.*, 2014b). This was also due to the agro-ecologies of Fedis district was mid-land moist zones which was favorable to aflatoxigenic fungi development and thereby aflatoxin contamination as compared to low-land dry zone of Babile and highland humid zones of Gursum districts. My observations also showed that these increases were due to poor harvesting, aflatoxigenic fungi infestation, pest damage, inappropriate cultural practices, and lack of knowledge of proper drying methods.

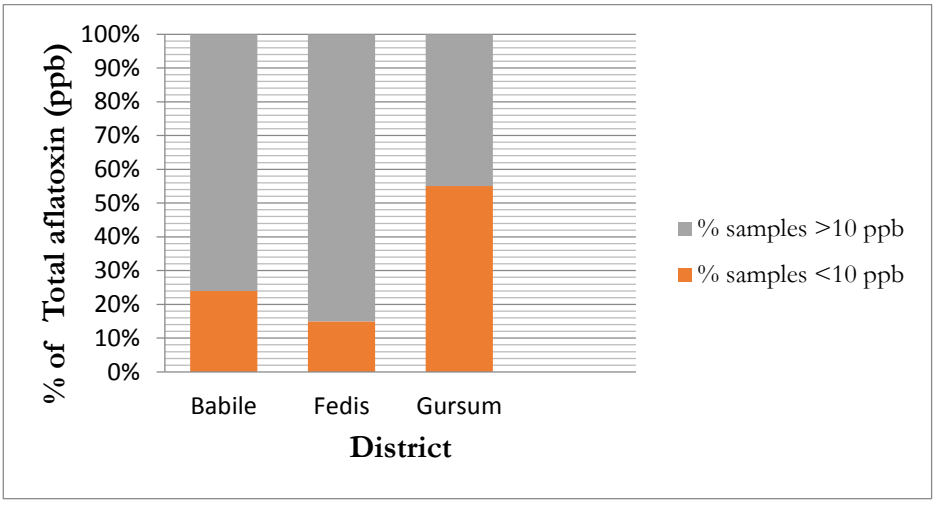

Figure 1. Percent of groundnut seed samples with aflatoxin levels above and below 10 ppb.

As it was also investigated through regression analysis of variance, aflatoxin levels with moisture contents were positively correlated (r = 0.860) and significant ($P \leq 0.05$) in groundnut seeds at farmers' fields. Aflatoxin levels were correlated to moisture contents of groundnut seeds following the equation of AFT FF=-10991 + 1130 MC FF, with R^2=0.74 means that 74% of aflatoxin levels were due to moisture contents of groundnut seeds (Figure 2).

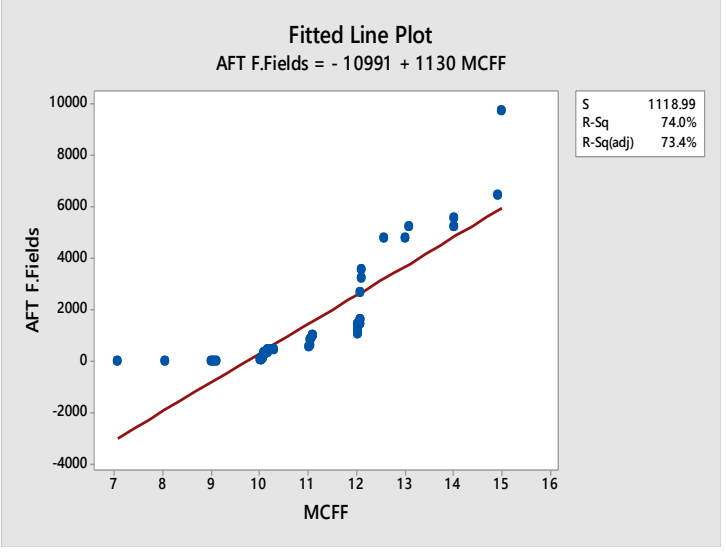

Figure 2. Regression analysis of moisture contents of groundnut seeds with total aflatoxin levels.

3.2. Prevalence of Total Aflatoxin at Farmers' Stores

A total of 45 groundnut seed samples were collected from farmers' stores of the three districts namely Babile, Fedis and Gursum. That means 15 samples were collected from farmers' stores at Babile district, 15 samples were from farmers' stores at Fedis district, and 15 samples were from farmers' stores at Gursum district. Percent of groundnut seed samples from farmers' stores with aflatoxin levels above and below 10 ppb in the three

districts is shown in Figure 2. Out of 15 samples tested for total aflatoxin concentration from Babile district, only 5 samples were negative while the remaining 10 samples were tested positive for aflatoxins. In terms of prevalence of total aflatoxin concentration in the positive samples, 55% were above 10 ppb and 45% were less than 10 ppb at farmers' stores at Babile district. From Fedis district, a total of 15 groundnut samples were tested for total aflatoxin concentration and only 3 samples were tested negative while the rest 12 samples were positive. In terms of percent prevalence of total aflatoxin concentration from the positive samples, 70% were above 10 ppb and 30% were less than 10 ppb at farmers' stores at Fedis district. As compared to Babile and Fedis districts, there were less groundnut seeds contamination by aflatoxin in Gursum district, where out of 15 samples, 8 were tested positive for aflatoxin and the remaining 7 samples were negative. In terms of percent prevalence of total aflatoxin concentration from the positive samples, 25% were above 10 ppb and 75% were less than 10 ppb at farmers' stores at Gursum district. These increases could be due to poor storage facilities, pest damage, inappropriate cultural practices, and lack of knowledge of proper storage methods.

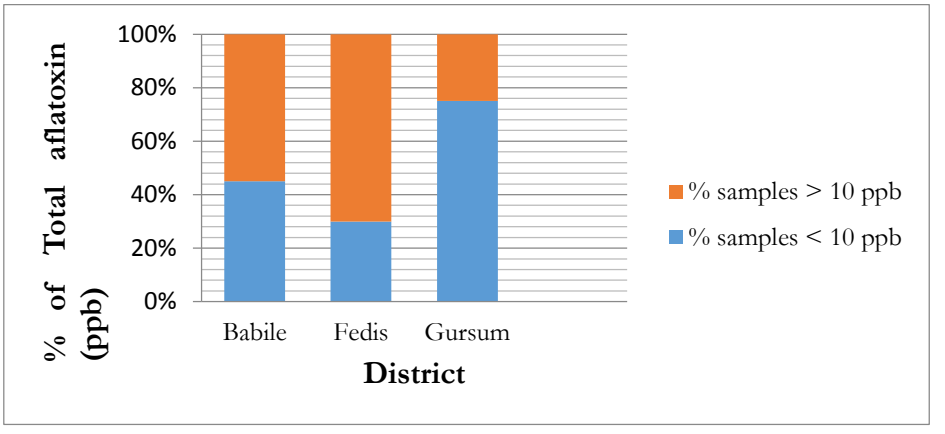

Figure 3. Percent of groundnut seed samples with aflatoxin levels above and below 10 ppb.

Figure 4 below showed regression analysis of variance of aflatoxin levels with moisture contents. The result revealed that aflatoxin levels with moisture contents were positively correlated (r = 0.956) and significant ($P \leq 0.05$) in groundnut seeds at farmers' stores. Aflatoxin levels were correlated to moisture contents of groundnut seeds following the equation of AFT FS=-11342 + 1681 MC FS, with $R^2=0.91$ means that 91% of aflatoxin levels were due to moisture contents of groundnut seeds from farmers' stores.

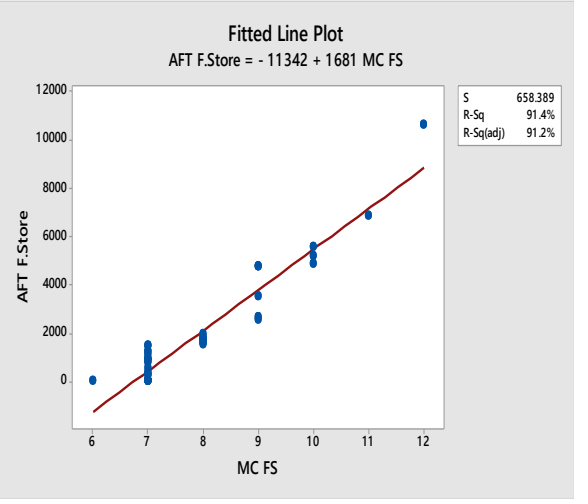

Figure 4. Regression analysis of moisture contents of groundnut seeds with total aflatoxin levels at farmers' stores.

3.3. Prevalence of Total Aflatoxin at Retailers

A total of 30 groundnut seed samples were collected from market retailers of the three districts namely Babile, Fedis and Gursum. That means 10 samples were collected from market retailers at Babile district, 10 samples were from Fedis district and 10 samples were from Gursum district. Percent of groundnut seed samples from market retailers with aflatoxin levels above and below 10 ppb in the three districts was shown in Figure 3. Ten samples were tested for total aflatoxin concentration from Babile district and only 5 samples were negative while the remaining 5 samples tested positive for aflatoxins. Prevalence of total aflatoxin concentration from the positive samples 35% were above 10 ppb and 65% were less than 10 ppb at market retailers at Babile district. From Fedis district, a total of 10 groundnut samples were tested for total aflatoxin concentration and only 4 samples were tested negative while the rest 6 samples were positive. In terms of percent prevalence of total aflatoxin concentration from the positive samples, 40% were above 10 ppb and 60% were less than 10 ppb at market retailers at Fedis district. As compared to Babile and Fedis districts, there was less groundnut seeds contamination by aflatoxin in Gursum district, where out of 10 samples, 3 were tested positive for aflatoxin and the remaining 7 samples were negative. In terms of percent prevalence of total aflatoxin concentration from the positive samples, 15% were above 10 ppb and 85% were less than 10 ppb at market retailers at Gursum district.

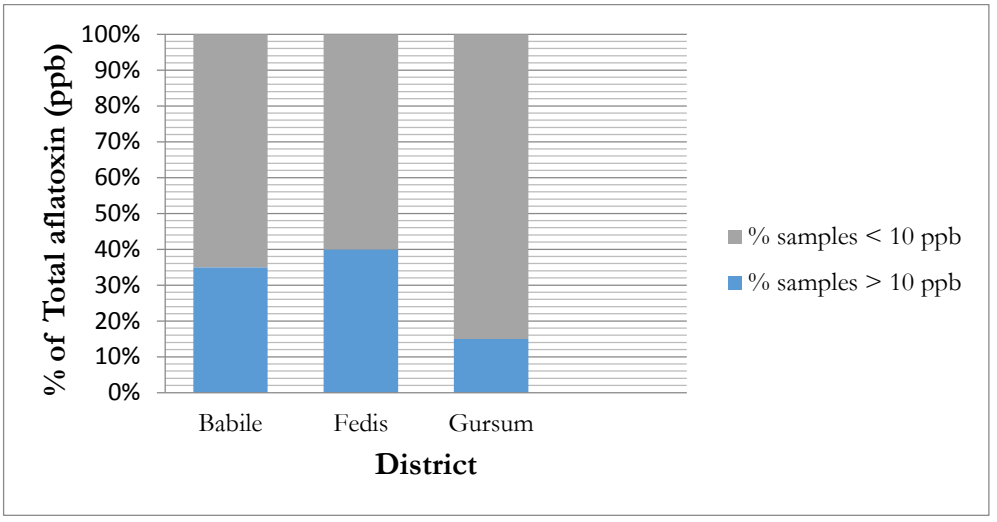

Figure 5. Percent of groundnut seed samples from market retailers with aflatoxin levels above and below 10 ppb.

Results of Figure 6 below showed that regression analysis of variance of aflatoxin levels with moisture contents were positively correlated (r = 0.981) and significant ($P \leq 0.05$) in groundnut seeds at market retailers. Aflatoxin levels were correlated to moisture contents of groundnut seeds following the equation of AFT MR=-36.07 + 78.37 MC MR, with R^2=0.96 means that 96% of aflatoxin levels were due to moisture contents of groundnut seeds from market retailers.

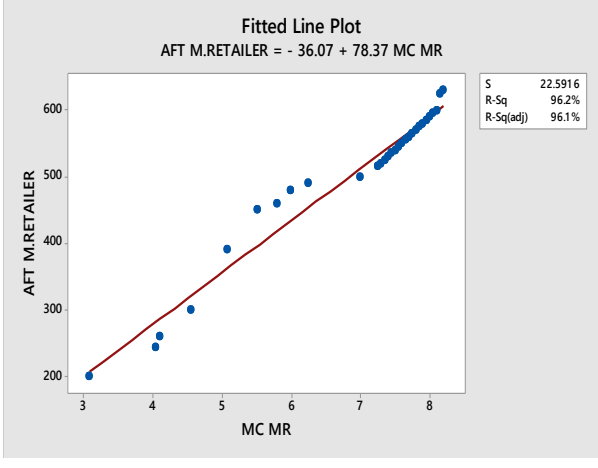

Figure 6. Regression analysis of moisture contents of groundnut seeds with total aflatoxin levels at market retailers.

3.4. Prevalence of Total Aflatoxin at an Open-Air Vendors

A total of 30 groundnut seed samples were collected from market retailers of the three districts namely Babile, Fedis and Gursum. That means 10 samples were collected from open-air vendors at Babile district, 10 samples were from open-air vendors at Fedis district and 10 samples were from open-air vendors at Gursum district. Percent of groundnut seed samples from open-air vendors with aflatoxin levels above and below 10 ppb in the three districts was shown in Figure 4. Ten samples were tested for total

aflatoxin concentration from Babile district and nine samples were negative while the remaining 1 samples tested positive for aflatoxins. In terms of percent prevalence of total aflatoxin concentration from the positive samples, 1% was above 10 ppb and 99% were less than 10 ppb at open-air vendors at Babile district. From Fedis district, a total of 10 groundnut samples were tested for total aflatoxin concentration and 2 samples were tested negative while the rest 8 samples were positive. In terms of percent prevalence of total aflatoxin concentration from the positive samples, 2% were above 10 ppb and 98% were less than 10 ppb at open-air vendors at Fedis district. As compared to Babile and Fedis districts, there was less groundnut seeds contamination by aflatoxin in Gursum district, where out of 10 samples, none were tested positive for aflatoxin. The reason why aflatoxin concentration in open-air vendors is low is because roasting kills aflatoxin producing fungi and hence groundnut seed roasting processes reduce the risk of aflatoxin contamination. The present study was in agreement with previous studies by Galvez *et al.* (2003) who have shown that groundnut seed roasting processes reduce the risk of aflatoxin contamination. This study revealed that there was higher risk of exposure to aflatoxin through raw than roasted groundnuts. Roasting is one of the effective physical methods to remove or reduce aflatoxin content in foodstuff and hence it reduces possible health risks associated with aflatoxin to the consumers.

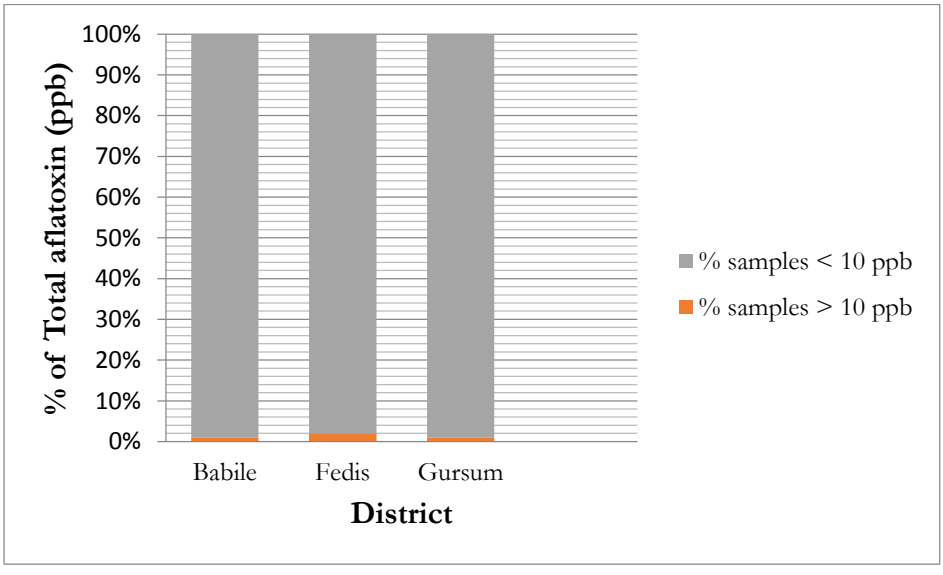

Figure 7. Percent of groundnut seed samples from open-air vendors with aflatoxin levels above and below 10 ppb.

Regression analysis of variance showed that aflatoxin levels with moisture contents were positively correlated (r = 0.927) and significant ($P \leq 0.05$) in groundnut seeds at an open-air venders. Aflatoxin levels were correlated to moisture contents of groundnut seeds following the equation of AFT VR=-1492 + 1405 MC VR, with $R^2=0.86$ means that 86% of aflatoxin levels were due to moisture contents of groundnut seeds from open-air venders (Figure 8).

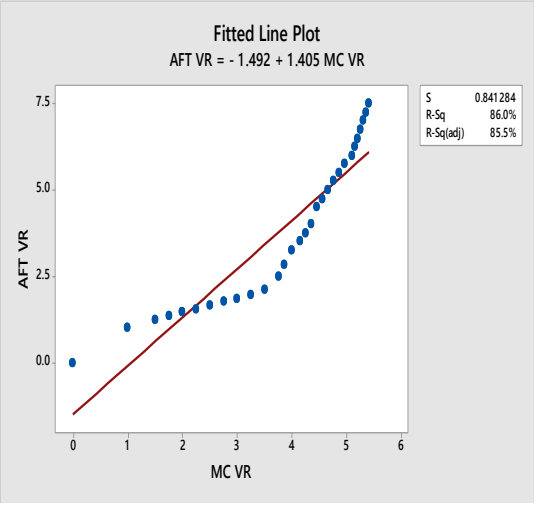

Figure 8. Regression analysis of moisture contents of groundnut seeds with total aflatoxin levels at venders.

Results from across the three survey districts suggest higher aflatoxin contamination of groundnut samples from the farmers' fields than from farmers' stores, market retailers and from open-air vendors, respectively. In general, when actors along the value chain were compared, the highest prevalence of total aflatoxin contamination was recorded at farmers' fields at Fedis district and the least was recorded at open-air vendors at Gursum district. When agro-ecologies were compared, prevalence of aflatoxin contamination was highest from farmers' fields in Fedis districts in midland moist agro-ecological zones and the least was from roasted groundnut seed samples of vendors in Babile, Fedis and Gursum districts in three agro-ecological zones. The high temperature and periodic drought prevalent in mid-land moist zone could explain the higher levels of aflatoxin contamination in that climate. In addition, unfavorable drying and storage practices may aggravate the problem. Moreover, the environmental conditions especially temperature and relative humidity and/or moisture prevailing in the mid-land moist zone may be responsible for this established trend.

The present study was in agreement with the work of Alemayehu *et al.* (2012) who have reported that total aflatoxin levels in *Aspergillus flavus* within positive samples of groundnut seed varied between 15 and 11865 µg/kg in Eastern Ethiopia. These results indicated heavy aflatoxin contamination of groundnut samples from Ethiopia, at levels much higher than any international acceptable standards, e.g. FAO and WHO acceptable limit being 15 µg/kg. Dereje *et al.* (2012) analyzed a total of 168 groundnut kernel samples collected from farmers and research center fields of northern Ethiopia for Aflatoxin B1 type and detected in all of the samples, ranging from 0.1 to 397.8 ppb (mean: 28.7 and median 5.2 ppb). The highest level of Aflatoxin was detected in groundnut samples from T. abergele area (55.3 ppb). Another study by Eshetu (2010) reported that aflatoxin concentration of 447 ppb and 405 ppb in samples stored for three months in Babile, East Ethiopia, and for a year in Awi in North Ethiopia, respectively. Another study by Amare *et al.* (1995) revealed 85% of *A. flavus* isolated from groundnuts in East Ethiopia being able to produce aflatoxins in a range of 1 to > 300 ppb in liquid medium. The aflatoxin concentration detected in the current study was generally much higher than these last two previous reports from Ethiopia. However, the aflatoxin concentration quantified in the current work is not uniquely high in Africa. A study conducted in Ghana by Awuah and Kpodo (1996) reported high levels of aflatoxins (5.7-22,168 ppb) in market groundnut

samples contaminated by a variety of fungi including *A. flavus*. Owing to these high levels of natural contamination of groundnuts by aflatoxins, the National Agency for Food, and Drug Administration and Control in Nigeria, has raised the maximum permissible limit for total aflatoxin in foodstuff to 20 ppb a level higher than the 5 ppb standard set by WHO (FAO, 2011).

Regression analysis of variance showed that aflatoxin levels were positively and significantly correlated with moisture contents in groundnut seeds along the value chain actors. The research results on seed moisture showed that the moisture content of samples ranged between 3 and 15%; the lowest was obtained from groundnut seed samples collected from vendors and the highest was from farmers' fields at harvest. According to Codex Alimentarius Commission, the maximum allowable moisture content in groundnut is 10% and it is known that above this maximum range supports mould growth during storage and can lead to aflatoxin contamination (CODEX, 2004). Rahmianna *et al.* (2015) reported that kernel moisture content is crucial in the incidence of aflatoxin contamination where the range of 18 to 28 % moisture content is critical level suitable for aflatoxin production. Other publication mentioned the number between 15 to 30 % and soil temperature higher than 28 ^{o}C during pod filling period in the pod zone. Below 15% and above 30% of moisture content were the safe levels. Rahmianna *et al.* (2015) reported that seed moisture content of ≤8% was able to inhibit *A. flavus* infection and aflatoxin contamination in groundnut seeds compared to those with seed moisture content >10%. According to Wagacha *et al.* (2013) moisture contents were significantly ($p \leq 0.05$) and positively correlated ($r = 0.76$) to aflatoxin contamination level of the peanut samples, which is in agreement to the present study.

In Ethiopia, some of food materials like preparation of red pepper powder and its paste showed some aflatoxin contaminations (mean 32 μg/Kg for powder, 1 paste sample had 102.2 μg/Kg aflatoxin B1 respectively) while samples of groundnuts and peanuts butter had aflatoxin B1 at mean values of 34.7 and 105 μgKg-1, respectively (Besrat and Gebre, 1981). In the European Union, regulations limit the amount of total aflatoxins to 4 ppb whereas guidelines in a few developing countries and the US limit total aflatoxins to no more than 20 ppb in food stuffs intended for human consumption (FAO, 2011). International standards based on the levels of aflatoxin, the groundnut samples analyzed were grouped into three categories: samples containing 0-4 ppb, samples with 4-20 ppb, and samples with > 20 ppb. Compared to this most of the groundnut samples from East Ethiopia had aflatoxin at a level much higher than any of these three classes. Results from across the value chain actors of the three survey districts suggest higher aflatoxin contamination of groundnut samples from the farmers' fields, farmers' stores and market retailers than those from the vendors. These results were obtained due to higher kernel infection by *Aspergillus* species of groundnuts in farmers' fields, farmers' stores and market retailors than those from the vendors. The reason that lower contamination of samples from vendors was that the samples were roasted groundnut seeds which did not support *Aspergillus* species infection and there by aflatoxin contamination. The aflatoxin concentration detected in the current study is generally higher from Ethiopia. Moreover, the aflatoxin concentration quantified in the current work is not uniquely high in Africa. A study conducted in Ghana by Awuah and Kpodo (1996) reported high levels of aflatoxins (5.7-22,200μg/kg) in market groundnut samples contaminated by a variety of fungi including *A.flavus*. A study by Mutegi *et al.* (2009) revealed that groundnut samples from Kenya have been contaminated by as much as 7530μg/kg of aflatoxin. Aflatoxin contamination is highly regulated in developed countries (Shepared, 2010) although factors inducing fungal spoilage and aflatoxin production are much more prevalent in developing countries (Kamika and Takoy, 2011).

4. Conclusions

Groundnut is one of the most important cash crops in eastern Ethiopia, and aflatoxins are common contaminants across the groundnut growing study areas. Results of the current study suggest heavy contamination of groundnuts by aflatoxin in East Ethiopia at a level much higher than any international standard. Investigation on groundnut contamination by aflatoxigenic fungi and associated aflatoxins should continue in groundnut producing regions across the country to come up with a complete picture of grain contamination both temporally and spatially. Such studies will serve as important basis to understand the full extent of the problem and also to work on appropriate control measures. The current result suggests an urgent need to control aflatoxin contamination. It is also necessary to make concerted campaigns to create awareness among farmers and traders about aflatoxin contamination and high quality maintenance in the groundnut value chain.

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14. Feed Resources and Livestock Production under Climate Variability and Future Climate Scenarios: Implications for Livestock Population and Supply Chain

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Abstract

Extreme climatic events significantly limit livestock performance in semiarid tropics. This study was conducted to assess the effect of climate variability on livestock population dynamics in pastoral communities of Shinile zone of eastern Ethiopia. Rainfall and El Niño-southern oscillation (ENSO) data from 1984-2015 were collected from National Meteorology Agency of Ethiopia and National Oceanic and Atmospheric Administration, respectively. The future rainfall trend was predicted with MarkSim (RCP 4.5 General Circulation Model). Livestock population was collected from Ethiopian Central Statistical Agency and the respective pastoral communities. The analysis of rainfall data revealed that there was higher inter-annual rainfall variability in pastoral areas during studied years. Cattle and sheep had positively and significantly associated with mean annual rainfall and ENSO events. But the population of goat and camel were not significantly associated with mean annual rainfall.. Such changes in climate are increasing the importance of camel and goats even though milk production per animal of camel and cow decreases now than the one 10 years ago. Cattle mortality and off-take rate had a significant negative relationship with rainfall variability. Natural pasture is the dominant feed resources available for livestock in the study districts, which fluctuates with season and becoming more impacted due to climate change. However, the future annual rainfall in the study pastoral districts would increase by an average of 6.63, 4.64 and 3.05% in the 2030, 2050 and 2080 respectively, with significant variability. Moreover, the maximum and minimum temperature is also expected to increase by an average of 1.76 oC and 1.94 oC in the 2100, respectively, as compared to the base period. Thus, rainfall variability and increasing temperature affect the livestock supply chain. In this study, we recommend appropriate early warning plan and proper management of water and rangeland, and implementing basic conservation mechanism to minimize the resulting irregular supply of livestock production in Shinile pastoral communities.

Keywords: Climate variability; El Niño; La Niña; mortality; off-take rate; prediction; trend analysis, supply chain

1. Introduction

The pastoral population of Ethiopia lives in the drier and hotter lowlands of the country, including the Somali and Afar regions (representing about 57 and 26% of the Ethiopian pastoralists); the Borana and Karrayu pastoralists in Oromia region, the Southern, Gambella and Benishangul regions that together account about 17% of the pastoral communities in Ethiopia (Sandford and Habtu, 2000). Pastoral production makes an immense contribution to the national economy by raising 40% of the cattle, 75% of the goats, 25% of the sheep, and 100% of the camels (Yacob, 2002). Beyond this, the pastoral system provides various livestock products and contributes significantly to the livelihoods of the people and to the country's economy at large.

Rainfall variability is the most understood features of climate variability, which naturally occurring phenomenon is resulting from an interaction between the ocean and the atmosphere over the tropical Pacific Ocean that has important consequences for weather around the globe, particularly in the tropics (NOAA, 2013). The El Niño-southern oscillation (ENSO) cycle is characterized by coherent and strong variations in sea-surface temperatures (SST), rainfall, air pressure and atmospheric circulation across the equatorial Pacific. Rainfall is the primary important climatic element that affects the availability of feed resources and livestock performance in most parts of Africa including eastern part of Ethiopia. Rainfall is the most essential climatic element but its variability becomes a problem in pastoral and agro-pastoral communities. Similarly, extreme weather events such as El Nino and La Nina are becoming common phenomena in pastoral and agro-pastoral communities. The continuous rise of temperature also induced prolonged droughts in semi-arid environments. Thus, such climatic variability affects livestock population and its supply chains negatively in pastoral communities as they are dependent upon rain-fed natural resources.

Shinile zone pastoral areas of eastern Ethiopia have frequently hit by rainfall variability and ENSO events leading to heavy livestock mortalities. However, information on ENSO episodes and other climate variability and how different livestock species respond to these extreme events and climatic shocks would be helpful for developing appropriate societal mitigation measures and planning strategies at national and local levels (Best *et al.*, 2007; Korecha and Barnston, 2013). Moreover, it is also critical to assess the expected future rainfall and temperature change to minimize stresses (Thornton *et al.*, 2009) and sustain livestock potential under the changing climate and global warming. However, knowledge on the effects of rainfall variability during ENSO episodes on livestock population dynamics at pastoral communities in eastern Ethiopia is either lacking or limited. Therefore, we studied the impacts of rainfall variability during ENSO events on livestock population dynamics (off-take and mortality rates), as well as challenges and adaptation strategies of pastoralists in Shinile zone of eastern Ethiopia.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in Shinile zone of Somali region of Ethiopia, representing pastoral production system (Figure 1). We selected Shinile zone for our study due to its potential in livestock population and vulnerability to frequent climate shocks. Shinile zone is located between 9°47' and 11°00'N Latitude and 40°69' and 42°94'E Longitude, at an altitudinal ranges of 500 - 1600 m above sea levels. Average annual rainfall for Shinile is 447 mm, ranging from 195 - 737 mm, and was highly variable among years with a coefficient of variation (CV) = 35.4% (1984-2015). Under normal condition, Shinile zone receives its highest rainfall amount during long rainy season (June - September)

while the short rains prevail from March - May. The mean daily minimum and maximum temperatures, from 1984 - 2015, were 19°C and 32°C, respectively. The zone is dominated by pastoral production system, where livestock is the main livelihood of the people, dependent up on communal grazing systems on rangelands as feed resources. Cattle, sheep, goat and camel are the major livestock types owned by the pastoralists in Shinile zone.

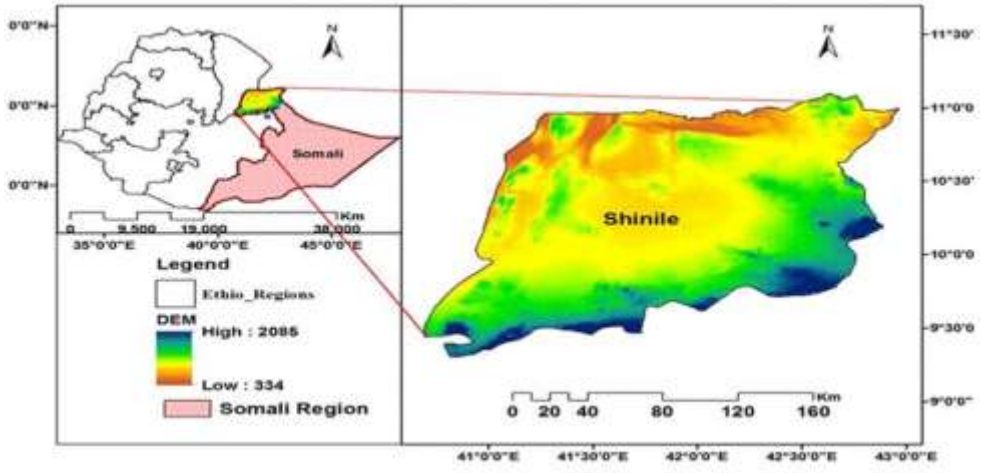

Figure 1. Location of the study area, Shinile zone in Somali region of Ethiopia.

2.2. Rainfall and Livestock Data

We used gridded (10 km x10 km) rainfall data obtained from National Meteorological Agency of Ethiopia (NMA), as the rain gage station available data for Shinile was not enough and have major discontinuity as the World Meteorological Organization recommended a 30 years rainfall data as a minimum for time series analyses of climatic change (IPCC, 1999). Annual rainfall data were collected during the period 1984-2015. ENSO data was collected from the (NOAA/CPC (National Oceanic and Atmospheric Administration/Climate Prediction Center), and IRI (International Research Institute for Climate Society) websites, as well as other international forecast centers (http://www.ncdc.noaa.gov/ and http://www.ncep.noaa.gov/). Based on this information seventeen neutral years and six La Nina years were included for the analysis. The livestock population data (cattle, sheep, goats and camels) from 1991-2015, as well as mortality and off-take rates of livestock species (2001-2015) as production performance indicators were collected from the Central Statistical Agency of Ethiopia (CSA, 1991-2015).

2.3. Challenges and Adaptation Strategies of Pastoralists

We used semi-structured questionnaires consisting of both open and close–ended questions to study the challenges and adaptation strategies of the pastoralists towards rainfall variability. Accordingly, 90 pastoralists were selected from the two *kebelles* (the smallest administrative units under district) (*kebele I n* = 40, *kebelle II n* = 50) using proportional random sampling to the overall livestock population size of each site and asked them about their strategies practiced and challenges faced to adapt and mitigate during ENSO events. Among the selected pastoralists, 25 of them were females as the engagement of women to livestock is higher under pastoral communities. Data were collected related to livestock population, milk yield and herd history, impact of rainfall variability on livestock population, as well as their adaptation strategies and challenges

against inter-annual rainfall variability. In addition, focus group and key informant discussions, classified by sex and age groups, were conducted to avoid specific group's idea dominance, as well as to include gender and household experiences. There were a total of four focus group discussions, two from each *kebelle* and each group accommodated 15 individuals who were not involved in the household survey. Moreover, household heads above 50 years were purposely selected for the interview during the survey (Bartlett *et al*., 2001), using unstructured interviews and direct discussion. Three local enumerators, knowledgeable of the local language (Somali language) had participated to administer the household survey.

2.4. Data Analyses

2.4.1. Analysis of rainfall trend and variability anomalies

Mann-Kendall's test was used for analyzing the trend of rainfall (Partal and Kahya, 2006) by using XLSTAT software. Variability of rainfall was analyzed using coefficient of variation (CV) (AMB, 2010; Ayalew *et al*., 2012; Gebre *et al*., 2013). The CV was calculated as$\frac{SD}{X} * 100$, where SD is standard deviation of rainfall and X is the long-term rainfall mean. The CV values below 20% show less rainfall variability, while CV values between 20 and 30% and >30% indicate moderate and high rainfall variability, respectively (ABM, 2010). Standardized Rainfall Anomaly (SRA) was calculated from long-term rainfall data as it indicates the status of drought frequency or inter-annual rainfall fluctuations in the study area. It is calculated from the monthly rainfall data as the difference between annual rainfall of a particular year and the long-term rainfall average divided by the standard deviation $[Z = X - X/SD]$.

The intensity of drought is categorized as extreme drought (SRA = ≤ -2), severe drought (-1.99<SRA< -1.5), moderate drought (-1.49<SRA< -1.0), close to normal (-0.99<SRA <0.99), moderately wet (-1.0<SRA<1.49), very wet (1.5<SRA <1.99), and extreme wet (SRA = ≥ 2).

2.4.2. Analysis of future climate scenarios

The future rainfall and temperature data specific to the study areas were downloaded from http://www.ccafs-climate.org/patternscaling/ using MarkSim (RCP 4.5 General Circulation Model (GCM)). Future rainfall data of Shinile zone for the period of 2020 – 2099 was downscaled and future rainfall and temperature changes were analyzed for three time slot centered in 2030 (2020-2049), 2050 (2040-2069) and 2080 (2070-2099) and compared its trend and variability with the current rainfall data (1984-2015).

2.4.3. Relationship between ENSO rainfall and livestock population

The relationship between livestock population, mortality and off-take rate of livestock with mean annual rainfall variability during ENSO years was determined by regression analysis. The chi-square test was used to compare challenges and adaptation strategies of the pastoral communities at the selected two *kebelles* against the inter-annual rainfall variability (ENSO years). In addition, data obtained from the sample households in relation to perceived impact, on impact of rainfall variability to rangeland productivity at pastoral communities in Shinile study sites were compared with Kruskal-wallis rank test.

3. Results

3.1. Trends and Variability of Rainfall

The annual and main rainy season rainfall data showed an increasing trend whereas the short rainy season indicated decreasing trend in Shinile zone of Ethiopia (Table 1). Moreover, there was higher inter-annual rainfall variability during the study years as reflected by the high CV (35.4%) and SRA. The rainfall trend indicated that 53% of its distribution was deviated from the normal. The SRA showed that 40% of rainfall was near moderate to high drought. Based on the SST data, the NOAA/CPC identified eight El Niño and six La Niña years, in Ethiopia from 1987 to 2015. The ENSO events rainfall analysis revealed that El Niño reduces the amount of rainfall during the long rainy season and increases its amount during the short rainy season, whereas, La Niña suppresses the short rainy season and enhances the long rainy season rainfall distribution in the study area (Figure 2). Among the El-Niño and La Niña years identified, more than half of the events had below normal rainfall distribution, leading to higher rainfall variability (Figure 3). Furthermore, the long-term rainfall data (1984 – 2015) indicated that drought occurred during the 1984, 2000, 2002, 2009 and 2011(Figure 3), of which year 2000 and 2002 are categorized in ENSO episode and contributed to lowering of cattle and sheep population, increase of mortality and off-take rate.

Table 1. Trends of annual and seasonal rainfall in Shinile zone of Somali region, Ethiopia (1984-2015).

Variable	Z_{mk}	Slope
Annual rainfall	0.139ns	+3.53
Long rainy season	0.215ns	+3.192
Short rain season	-0.101ns	-1.071

Z_{mk} is Mann-Kendall trend test, Slope (Sen's slope) is the change (mm)/annual; ns is non-significant at 0.05. The mean seasonal and annual rainfall trend recorded, - value is decreasing trend and + values is an indication of increasing trend.

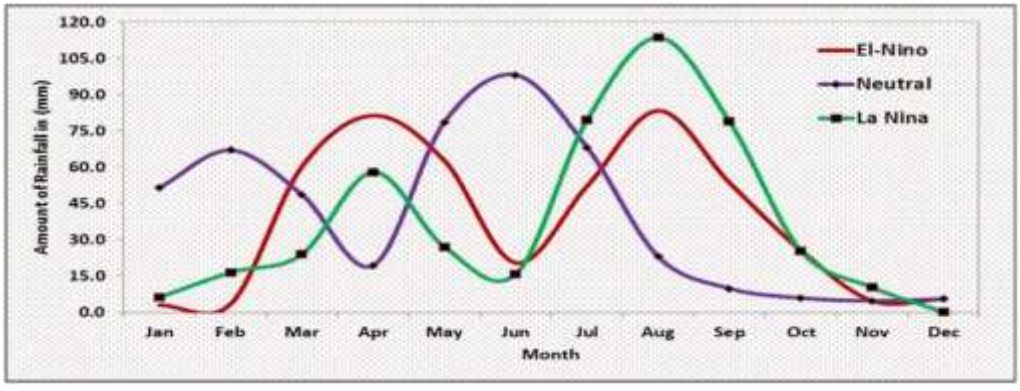

Figure 2. Mean monthly standardized rainfall anomalies observed during El Niño, La Niña and neutral episodes in Shinile zone of Somali region (1984-2015).

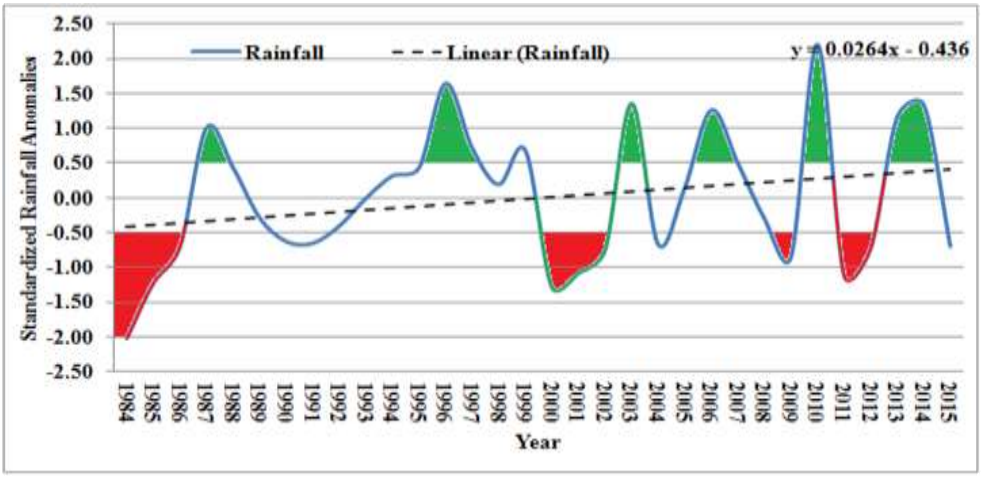

Figure 3. Standardized mean annual rainfall anomalies of Shinile zone in Somali region (1984–2015).

Note: The red colour indicated moderate to extreme drought periods, whereas the green showed moderate to extreme wet years.

3.2. Relationship between Rainfall Variability and Livestock Population

According to the results of this study, cattle and sheep are more affected by rainfall variability than goats and camels. Camels are more tolerant to rainfall variability. This can be supported by a positive relationship between cattle and sheep population and mean annual rainfall in Shinile zone (Figure 4). The cattle and sheep population was positively correlated to sheep population ($r = 0.74$, $P<0.05$). Moreover, El Niño reduces the amount of rainfall during the long rainy season as a result the livestock population during this time was declined (Figure 5), whereas La Niña suppresses the short rainy season and enhances the long rainy season rainfall distribution; as a result reduce cattle and sheep population in the study area (Figure 6). Pastoral communities mostly depend on the rainfall during the main rainy season for availability of pasture and water resources. Hence, declining of rainfall during this period has resulted in severe livestock loss. Cattle and sheep population was lower ($P<0.05$) during most El Niño and La Niña events in the study area. In addition, the population of goat and camel were also lower during ENSO events. Based on adaptability to the current rainfall variability due to ENSO events, livestock species studied had the following ranking: camel>goat>sheep>cattle under pastoral communities of Shinile zone of Ethiopia.

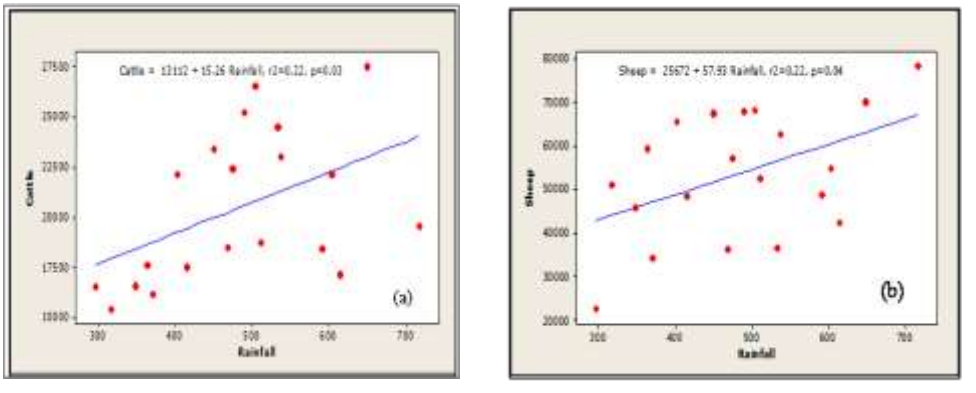

Figure 4. Relationship of mean annual rainfall to cattle (a), sheep (b) population under pastoral communities.

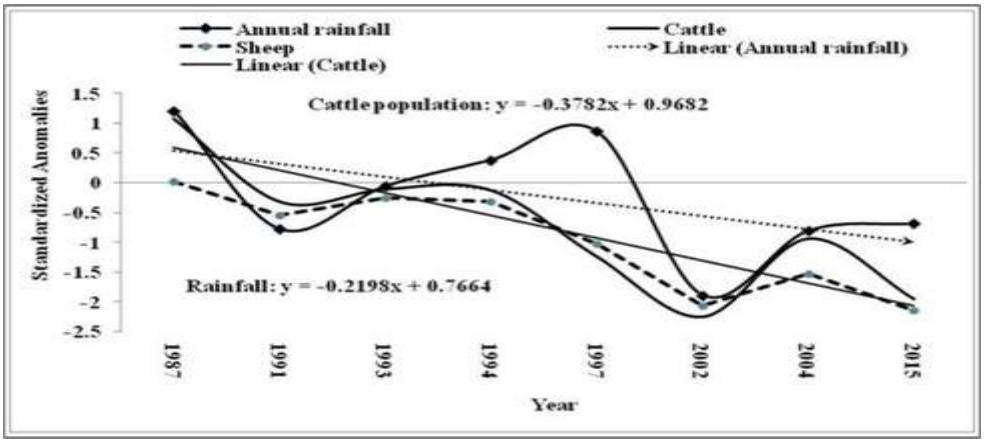

Figure 5.: Trends of standardized livestock population (cattle, sheep) and rainfall anomalies observed during El Niño episodes (1987 – 2015).

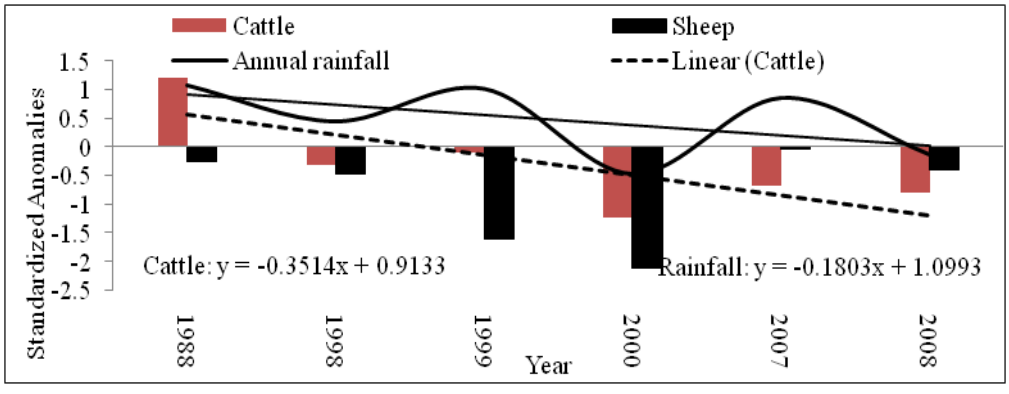

Figure 6. Trends of standardized cattle, sheep and rainfall anomalies observed during La Niña episodes (1988- 2008).

3.3. Effect of Rainfall Variability on Milk Production

Most respondents indicated that livestock population per household in Shinile zone was estimated to decrease significantly ($p < 0.05$) over ten years. The average numbers of livestock per household before 10 years has declined from 7.41 to 3.24 cows, 6.59 to 4.28 sheep, increased from 8.31 to 14.59 goats, and increased from 11.28 to 17.31 camels as compared with the current population. Furthermore, cow milk per household also decreased from 2.1 to 1.4 liters and camel milk decreased from 8.1 to 4.4 liters (Table 2). This result indicates that the number of camels, for instance, was highly increased in the last ten years possibly due to the shifting of pastoralist production systems from cattle more towards camel following severity of climate variability and change. On the other hand, the amount of milk produced per camel per day before 10 years was higher than the current value. This shows a sharp decline in milk yield per animal over the last 10 years which may be a consequence of climate variability and change in the study area and associated shortage of feed and water that also make the animals more sensitive to diseases. This in part negatively affects the supply of milk and meat to producers and consumers.

Table 2. Comparison of livestock population and milk volume obtained per day with related to rainfall variability and change (N = 90).

Variable	Min.	Max.	Mean	SD
Livestock population				
Cow numbers before 10 years/HH	2	10	7.41	3.23
Current cow numbers/HH	1	4	3.24	1.96
Sheep numbers before 10 years/HH	4	12	6.59	3.64
Current sheep numbers/HH	2	6	4.28	1.27
Goats numbers before 10 years/HH	3	13	8.31	4.54
Current goat numbers/HH	4	23	14.59	13.12
Camel numbers before 10 years/HH	4	16	11.28	9.24
Current camel numbers/HH	5	32	17.31	15.85
Milk yield				
Milk yield/cow before 10 years (lit/day)	1.5	2.3	2.1	0.62
Milk yield/cow now (lit/day)	0.9	1.5	1.4	1.29
Milk yield/camel before 10 years (lit/day)	6	10	8.1	2.27
Milk yield/camel now (lit/day)	4	7	4.4	1.29

Note: Min= minimum; Max = maximum; SD=Standard Deviation; HH= Household.

3.4. Relationship between Rainfall Variability, Livestock Mortality and Off-Take Rate

Cattle mortality rate was increased with decreasing mean annual rainfall ($P<0.05$) in pastoral communities. Sheep, goats and camels mortality also showed negative association to low rainfall distribution. Cattle mortality was also higher during most El Niño (Figure 7) and La Niña years, when mean annual rainfall was lower than normal distribution. Moreover, cattle off-take rate were higher in most La Nina episodes in the study area (Figure 8). For instance, in La Niña years 2008, cattle mortality was increased by 12.4%, sheep 26.2%, goats 6.5% in Shinile pastoral communities.

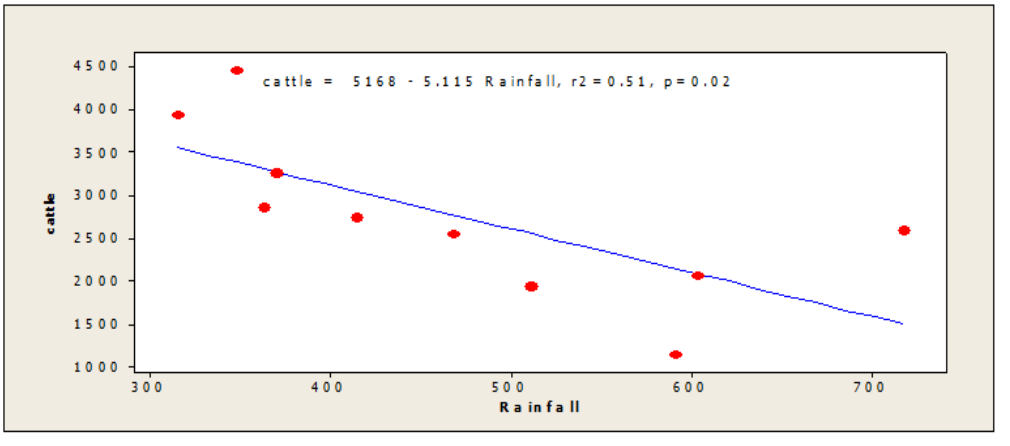

Figure 7. Relationship of mean annual rainfall to cattle mortality during El Niño episodes under pastoral communities of Shinile zone of Somali region, Ethiopia.

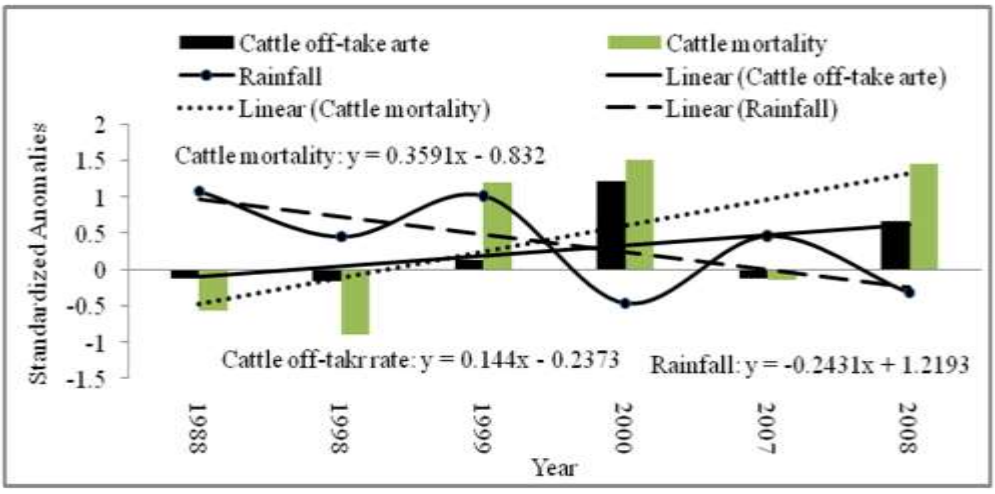

Figure 8. Trends of standardized rainfall, cattle mortality and off-take rate anomalies observed during La Niña episodes in Shinile zones, eastern Ethiopia.

3.5. Challenges and Adaptation Strategies of Livestock Herders towards Rainfall Variability

The majority of the respondents had the knowledge that the patterns of rainfall distribution reduce the livestock performance and increase the mortality and off-take rate through reducing the availability of pasture and water resources, leading to disturbance of the demand and supply chains. Accordingly, livestock herders applied different adaptation strategies to reduce the impact of rainfall variability on livestock population. Pastoralists tend to practice settling around watering points and practice seasonal mobility (Table 3). On the other hand, some livestock herders did not practice adaptation strategies due to several adaptation challenges including poor access of climate information and ENSO knowledge (Table 4).

Table 3**.** Adaptation strategies (%) of sampled respondents to extreme climate variability.

Adaptation strategies	Kebele I (N=40)	Kebele II 9N=50)	P value
Settlement around watering points	91	90	>0.05
Mobility	86	87	>0.05
Destocking	83	71	>0.05
Increasing species composition	75	50	<0.05
Supplementation	69	45	< 0.05

Table 4. Adaptation challenges (%) of sampled respondents to extreme climate variability

Adaptation challenges			P value
	Kebelle I	*Kebelle II*	
Poor climate information access	91	85	>0.05
Shortage of water points/deep water table	86	78	>0.05
Restriction of mobility	82	67	>0.05
Bush encroachment	74	52	<0.05
Population pressure	71	41	<0.05

3.6. Pastoralists Perception on Impacts of Rainfall Variability on Feed Resources

The majority of respondents believe that the rainfall variability reduces water and feed availability for livestock (Table 5). All pastoralist respondents perceived the disappearance of palatable browsing and grazing species and dominance of invading species, which reduces the productivity of rangelands (Table 6) further leading to overgrazing of natural pastures and land degradation. For these reasons, feed shortage has become a serious problem for all types of livestock species.

The majority (87%) of the respondents agreed on the rangeland degradation loss in productivity of rangelands, while the rest believed the opposite. Similarly, field observation and interview indicate that there is invading and encroachment of new species in the rangelands of the study areas. About 71% of pastoralist respondents replied that there is occurrence of conflicts between the community due to shortage and depletion of rangeland resources.

Table 5. Possible perceived impact of rainfall variability to feed shortage (N=90).

Strategies	Ranking by pastoralists
Pasture/water availability decreased	1.05[a]
Invasive species increased	2.08[b]
Bush encroachment increased	3.14[c]
Species composition decreased	3.91[d]
Rangeland degradation increased	4.28[e]
Traditional natural resource management practices weakened	4.32[e]

Note: The lower the Kruskal –Wallis value the higher the impact.

Table 6. Some of the woody and herbaceous plant species disappearing and replaced due to climate variability.

Disappearing woody plant species	Currently dominant species
Hamareessa (*Accacia brevispica*)	*Opuntia ficus*-indica,
Barkatkattee (*Lantana camera*)	*Prosopis juliflora*
Haroressa	
Qudhac (*Accacia nilotica*)	
Qudhac (*Accacia tortolis*)	
Qudhac (*Accacia mellifera*)	

3.7. Prediction of Future Climate Scenario in Shinile Pastoral Areas

The prediction of future amount of annual rainfall would increase by 2030, 2050 and 2080s under RCP 4.5 scenario in the study area (Figure 9). The annual rainfall will increase by 11.4, 9.4 and 5.9% in 2030s, 2050s and 2080s, respectively. The future annual rainfall is also predicted to be variable (CV = 30.5%). Moreover, the future temperature tends to increase as compared to the base period. The maximum temperature in the study area is expected to increase by an average of 0.67, 0.57 and 0.52^{o}C in the 2030, 2050 and 2080, respectively compared to the current maximum temperature. The minimum temperature is also estimated to increase by 0.42, 0.9 and 0.63^{o}C in the 2030, 2050 and 2080, respectively.

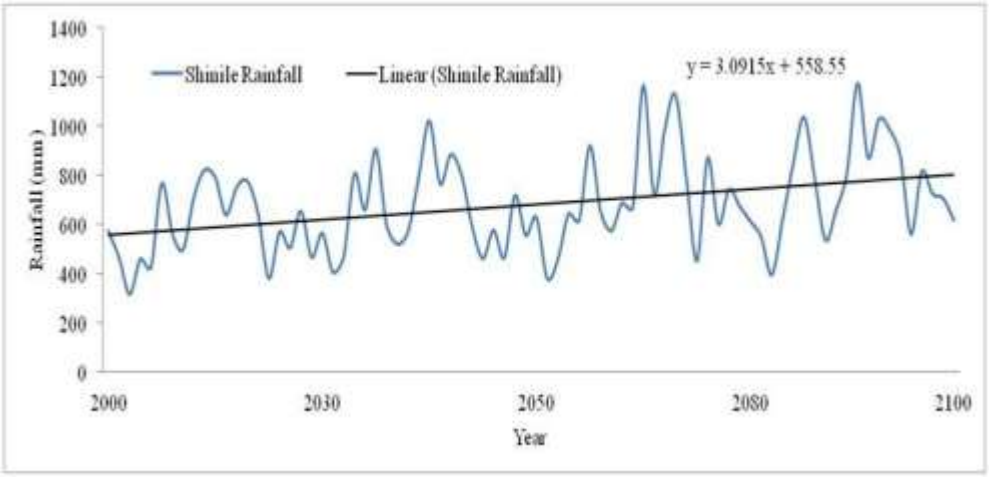

Figure 9. Trends of current mean annual rainfall and its future prediction scenarios (1984 – 2100).

4. Discussion

The rainfall characteristics from 1984 to 2015 had indicated that there was a clear inter-annual and seasonal rainfall fluctuation, with a high CV values. Consequently, this rainfall variability would lead to extreme drought condition, reducing livestock population under pastoral communities in the study area. Omondi *et al.* (2012) indicated the existence of declining rainfall amount as a result of climate variability in most parts of the dry lands. Similarly, declining of rainfall has been documented during climate variability and change in southern Ethiopia (Viste *et al.*, 2013), in Amhara region (Ayalew *et al.*, 2012) and in central rift valley of Ethiopia (Tsegaye *et al.*, 2015). Usually, El Niño and La Niña episodes occur when SST deviate from normal, which might be associated with the result of ocean atmosphere variability internal to tropical Pacific Ocean (Seleshi and Zanke, 2004). Moreover, based on SRA analysis, rainfall ranged between normal to high drought, which is consistent with another research conducted in other African country (Sherwood, 2013, Kgosikoma and Batisani, 2014). Such droughts have the potential to increase loss of livestock that would devastated the fragile livelihoods of pastoral communities and where alternative livelihood options are limited (Kgosikoma and Batisani, 2014), particularly women (Sherwood, 2013).

Reduction of rainfall during El Niño and La Niña would create severe drought, leading to reduction of pasture and water availability that cannot support all the livestock population. As a result of this phenomenon, livestock population showed a decreasing trend. In this study, more than half of El Niño and La Niña events were coincided with lower rainfall distribution, and reducing livestock population and higher mortality and off-take rate of cattle and sheep. In the study area, livestock population is mainly depending on long rainy season as the short rainy season is not mostly reliable. In addition, the long rainy season is more essential for forage production and replenishment of water resources and hence the declining trends of long rainy seasons determine livestock population and mortality. Previous studies also suggested that drought have mostly occurred due to failure of long rainy season (Angassa and Oba, 2007; Viste *et al.*, 2013; Megersa *et al.*, 2014). As a result, El Niño events were more severe than La Niña on livestock population and mortality in the study areas.

Our findings show that cattle and sheep population was lower during ENSO period of the study area, while pastoralists were forced to diversify drought tolerant species such

as goats and camels. Studies in Afar (Tilahun *et al*., 2016) and Borana pastoral communities (Abebe *et al*., 2012; Megersa *et al*., 2014; Brigham *et al*., 2015) have indicated that herd diversification were the results of shifts in vegetation from grassland to woodland. This could be due to shortage of feed and water availability, as a result conception and birth rate of livestock is reduced, which leads to increasing mortality and unplanned supply of livestock sales to the market (Brigham *et al*., 2015). In addition, the population of goat and camel were not significantly reduced with ENSO annual rainfall distribution. This could be that goats and camels are more adapted to low rainfall distribution compared to cows and sheep. In addition, the replacement of grasses with less palatable woody plants due to climate variability might affect cattle and sheep population than goats and camels population (Abebe *et al*., 2012). Moreover, goats and camels are able to utilize the available browse and bushes species better than sheep and cattle under lower rainfall distribution. Moreover, similar studies have also supported the dependency of goats and camels herding rather than cattle and sheep dominancy to use the available feed resources more effectively (Teshome *et al*., 2010; Megersa *et al*., 2014). Furthermore, camel is more selected by livestock herders during high rainfall variability due to its relatively higher milk production abilities and market price which can be easily converted into cash and income generation than other livestock population (Tilahun *et al*., 2016); as a result goats and camels used as an adaptation mechanism against frequent extreme rainfall variability.

Respondents had already perceived declined and irregular supply of livestock and milk production due to rainfall variability. This study agrees with the report of Dawit and Habtamu (2011) who indicated that cows declined from 9 to 3, ox from 4 to 2 in Amhara and Oromia regions of In addition, cow milk declined from 2.7 to 1.5 and camel milk from 10.8 to 2.9liters, in Amhara and Oromia region. This could be linked to shortage of feed and water due to rainfall variability and drought. Ethiopia. FSS (2009) had also recorded similar findings of reduction from 10 to 7 oxen, and 37 to 7 cows.

In in study, there was higher mortality of livestock during periods of droughts. This could be due to traveling of long distance of pastoralists with their animals in search of better grazing and water resources under low rainfall seasons, leading to severe mortality of livestock population (Desta and Coppock, 2002). Moreover, appropriate rainfall is more important for the growth and production of forages and water resources, and the variability of rainfall is serious problem to the livestock production. A similar finding is also observed in Borana pastoral areas by Megersa *et al.* (2014) who documented that shortage of grazing lands and climate variability are the major cause of declining livestock population and its productivity. Similarly, the highest mortality of sheep, goat and camel was observed in year 2000 and 2002 at times of ENSO events. Most of the ENSO year in the study areas caused a higher livestock mortality due to shortage of feed and water resources as a result of below normal rainfall distribution. The off-take rate of animals was lower during most neutral years. This could be associated with normal rainfall distribution, which minimizes mortality and off-take rate and increases births which lead to increasing livestock population (Mapiye *et al*., 2009). Hence, this could be partially explained the importance of rainfall on vegetation and water sources for livestock (Ward *et al*., 2004). As a result the pastoral communities forced to sale large number of poor body conditions of their animals usually at lower prices to purchase food grain for their family members during drought events (Brigham *et al*., 2015).

According to Lobell *et al.* (2008) rainfall variability causes increase intensity and frequency of droughts, which affect the productivity of livestock. Moreover, Thornton *et al.* (2009) also reported that climate change affects livestock productivity by altering the quantity and quality of feed available for animals especially, in areas where extreme rainfall

variability occurred. According to World Bank (2010) an outbreak of El Niño event in 1997 has led to a death of up to 80% of the livestock population in Somalia and northern Kenya. Moreover, in Borana pastoralists who depend on animals for livelihoods and subsistence, lower than average rainfall recorded during 1999-2005 caused mass die-offs of livestock (Conway and Schipper, 2010). This indicates that there is a strong relationship between livestock population and rainfall distribution (Desta and Coppock, 2002; Angassa and Oba, 2007; Tache and Sjaastad, 2010).

Pastoralists had already understood a declined trend of water and pasture availability, and livestock population during low rainfall periods and applied different strategies to reduce the impact of climate variability. In Shinile zone pastoralists used settlement around watering points and get supplement of feed to save their livestock. Pastoralists used O. *ficus-indica* and browse trees during low rainfall distribution and feeds supplementation of crop residues and hay supplied by government and non-governmental organization to reduce drought impacts. Mobility and splitting of herd in to different places was practiced to get water and forage for their animals. In addition pastoralists also applied destocking some of their cattle, sheep, and goats during ENSO events. Such strategies were not practiced through organized marketing system and in time rather forced to sell their animals with lower prices. Though a large number of respondents interviewed applied different adaptation strategies, some pastoralists did not practice adaptation strategies due to several challenges.

Pastoralist's mobility together with their livestock is necessary and practiced in the study areas to live harmony with the changing climate. Mobility was used to be the first option by pastoralists as adaptation strategy during drought periods, but these days, it becomes the second option because livestock herders afraid of intra and inter-ethnic conflicts that could be arising due to shortage of pastures and water resources in most parts of neighboring rangelands in the study area. Moreover, the region has tended to encourage settlement of pastoralists for better intervention and expansion of private investment due to the availability of vast rangelands. Such anticipation might create increased population growth (Berhanu *et al*., 2013), affect traditional resource management system, reduce livestock holding per house hold and fragmentation of communal rangelands (Tilahun *et al*., 2016). Similar findings were also observed in Borana pastoral communities, in that mobility is an adaptive mechanism to reduce feed and water shortage in arid environment (Feye, 2007; Abebe *et al*., 2011). Although the importance of ENSO events to Ethiopian rainfall distribution pattern is being accepted and incorporated in the NMA's operational forecasting policy more now than previously, the intention to aware the impact and get ready the pastoral communities beforehand to reduce the resulting incidence to be somewhat underweighted. As a result, loss of livestock and destocking with low price is common during such events. For instance, recent El Niño year in 2015 lost 63.6% of the sheep, 48.4% of the goat, 31% of the cattle, and 19% of the camel population in pastoral areas of Shinile district.

Expected future rainfall scenarios revealed that the annual rainfall most likely to increase in Shinile pastoral area in the predicted years, and coincide with the IPCC (2007) report which stated that there would be an increased rainfall in parts of east Africa. In contrast, decreasing trend of future annual rainfall was reported by Tsegaye *et al.* (2015) in the rift valley of Ethiopia. Differences in topography, altitude, and atmospheric interaction might contribute for such variation. Despite the future rainfall prediction has indicating its increment, the variability is likely to limit the availability of water and feed supply. Our results are consistent with the work of Lobell *et al.* (2008), suggesting rainfall variability is the cause for increased intensity and frequency of droughts, which affect the productivity of feed resources and livestock.

Similarly, Beier *et al.* (2008) and Kassahun *et al.* (2008) have shown the consequence of decreasing rainfall on reduction of the quality and quantity of forage. This leads to sudden decline of livestock performance and deterioration of livestock body condition. These fodder and water and harsh climatic conditions of the area seriously affect the health and productivity of animals (Rufael *et al.*, 2008). Prediction of rising temperature is also expected to be a major cause of reduced livestock performance. Nardone *et al.* (2010) also argue that rising temperature may directly affect thermal stresses on animals, reduce feed intake, and impairs metabolic activities, thereby hindering their performance. Moreover, Thornton *et al.* (2009) also documented that higher temperature also affect the population and productivity of livestock in pastoral and agro-pastoral production systems through indirect impacts on feed and water availability and disease distribution. Thus, the annually predicted rainfall variability and increasing temperature may affect livestock population, mortality and off-take rate in Shinile pastoral areas.

5. Conclusions

Inter-annual rainfall variability and ENSO episodes are a threat to livestock production and feed resources in Shinile zone of eastern Ethiopia and affect the livestock population and productivity, especially sheep, cattle and cow milk. The current result identified that livestock population and its supply chain was highly affected by rainfall variability. Generally, information generated in the current study highlights the meaningful impact of extreme environmental condition on pastoral economic system in terms of food security and income generation. In addition, adaptation challenges put the system under pressure in the study area. Hence, there is a need to design long term early warning systems with the participation of the host community at ground level to minimize the severity of extreme drought episodes on the livelihood of livestock herders and marketable supply of live animals and its products in arid and semi-arid pastoral areas of eastern Ethiopia.

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15. Stakeholders' Awareness and Knowledge about Aflatoxin Contamination of Groundnut (Arachis hypogaea L.) and Associated Factors in Eastern Ethiopia

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Abstract

Groundnut production is constrained by Aspergillus species, which produce aflatoxins. The objectives of this study was to assess stakeholders' awareness and knowledge about aflatoxin contamination along the groundnut value chain and its associated problems and to analyze stakeholders' perceptions about pre- and post-harvest practices affecting groundnut quality and aflatoxin contamination. The study was conducted in groundnut growing areas in Eastern Ethiopia. Primary data were collected using a semi-structured self-administered questionnaire on 165 randomly selected stakeholders. The result showed that 90% of the actors (i.e. 98.7% farmers, 96.7% traders and 70% consumers) were unaware of aflatoxin contamination and its consequences. Moreover, there was no significant difference in responses between farmers (97.3%) and traders (96.7%) in knowledge of long-term exposure to aflatoxigenic fungi and aflatoxin. Marriage, educational level and household income were the main factors significantly associated with knowledge about fungi and aflatoxin contamination in groundnut. Generally, there is low stakeholders" awareness and knowledge about aflatoxigenic fungi and aflatoxin contamination in groundnut along the value chain actors. It is necessary to make concerted campaigns to create awareness among farmers and traders about aflatoxin contamination and its associated problems.

Keywords: Aflatoxin; awareness; Ethiopia; groundnut; value chain actors.

1. Introduction

Groundnut (*Arachis hypogaea* L.), which is also known as peanut, earthnut, monkeynut and goobers, is an annual leguminous oil crop. It is currently grown on 25.2 million hectares worldwide with a total production of 35.9 million metric tons, with developing countries in Asia (66%) and Africa (25%) as the major producers. Groundnut kernels contain 40-50% fat, 20-50% protein and 10-20% carbohydrate and are rich in vitamin E, niacin, riboflavin, thiamine, falacin, calcium, phosphorus, magnesium, zinc, iron and potassium (USDA, 2010). In Ethiopia, during 2015 it was cultivated on 67,062 hectare of land and 103,940 tons of groundnuts were produced, with average yield of 1.55 tons per ha (CSA, 2015).

Infection of groundnut seed by molds, mainly *Aspergillus flavus* Link ex Fries and *Aspergillus parasiticus* Speare can result in contamination of the seed with aflatoxins, which are toxic fungal secondary metabolites (mycotoxins). Aflatoxins are a group of structurally related toxic polyketide-derived secondary metabolites produced by certain strains of *Aspergillus flavus* and *Aspergillus parasiticus* under special environmental or storage conditions (Waliyar *et al.*, 2006).

Aflatoxin contamination of agricultural commodities poses considerable risk to human and livestock health and has a significant economic implication for the agricultural industry worldwide (Richard *et al.*, 2003). It was reported that income losses due to aflatoxin contamination cost an average of more than US$100 million per year to US producers (Coulibaly *et al.*, 2008). According to Cardwell *et al.* (2004), aflatoxin contamination of agricultural crops, such as groundnut and cereals, causes annual losses of more than US$750 million in Africa. According to FAO (2002), developing countries account for approximately 95% of the world groundnut production, but are unable to sell large quantities of groundnut on the international market because of aflatoxin contamination. For instance, a food processing company in Ethiopia imported groundnuts from India, while groundnut producers in Gursum and Babile could not find market to sell their crop (Amare Ayalew, personal communication).

Outbreaks of acute aflatoxicosis from contaminated groundnut in humans have been documented in Kenya, India, Malaysia and Thailand (CAST, 2003). One of the first major documented reports of aflatoxins in humans occurred in 150 villages of western India in 1974 where 397 persons were affected and 108 persons died (Krishnamachari *et al.*, 1975). Conway and Toeniessen (2003) asserted that the safety of food and feed for human and animal consumption should be of top most priority with regards to agricultural and food industries. Those growers involved in farming venture in sub-Saharan Africa constitute about 70% of the population, and food commodities are the major items of international trade for many African countries. According to Bhat and Vashanti (1999), the quality and safety of food is important so that domestic and foreign markets are not compromised by the sale of low quality or unsafe food.

In 2005, FAO/WHO argued it is imperative that food safety remains a concern in all situations to derive maximum benefit from even the little available food and strong political will and hence relevant food safety systems are essential from production to consumption. The two organizations explained that the AFR/RC53/R5 resolution, which was developed by the WHO Regional Committee for Africa and that urged countries to strengthen food safety program, was endorsed in 2003 and since then many countries have initiated various activities to improve food safety. This strategy on food safety consolidates past gains and provides a framework for protecting public health and economic development through reduction of the burden posed by food-borne diseases.

There is also the issue of the level of aflatoxin awareness that negatively influences food safety and food security in developing countries since the level of awareness in many developing countries is extremely low or non-existent altogether. According to James *et al.* (2004), poor knowledge of aflatoxin and its health risks causes consumers to be exposed to acute and chronic toxicity through consumption of poor quality or molded groundnuts.

In Ethiopia, Information on aflatoxin contamination of groundnut and the associated fungi and health risks is scanty, confined to limited market samples, and does not particularly address the situation at harvest. Such studies would be more meaningful if they address the entire groundnut value chain covering major nodes from production through storage to consumption (markets), since they could support decision making targeting major points of aflatoxin contamination and averting its negative consequences.

Moreover, despite the importance of the problem, there are no recommended research results for groundnut aflatoxin management in Ethiopia. There is a need for identification of the gaps in producers'/traders' and consumers' awareness about the aflatoxin generation and/or contamination problem and its causal/contributing factors.

The present study was, therefore, launched to assess stakeholders' awareness and their knowledge about aflatoxin contamination along the groundnut value chain in eastern Ethiopia; and to determine the stakeholders' perceptions about groundnut qualities with respect to aflatoxin contamination and pre- and post-harvest practices affecting development of aflatoxigenic fungi and aflatoxin contamination.

2. Materials and Methods

The study was conducted in major groundnut growing areas (Babile, Fedis and Gursum Districts) of East Hararghe Zone, Oromia Regional State, eastern Ethiopia in 2014 crop season. The areas were selected purposively as they represent the bulk of groundnut production in Ethiopia (Alemaw and Alemayehu, 1991). These areas have high potential for rain-fed groundnut production nationally (Ephrem *et al*., 2014a).

The groundnut value chain in Eastern Ethiopia comprises farmers, traders (wholesalers and retailers) and marketing cooperatives; rural, urban and semi-urban markets, and consumers. Descriptions of the groundnut value chain are described in (Ephrem *et al*., 2014a).

2.1. Methods of Data Collection

The study covered 75 farm households and 30 traders. In addition, 30 consumers were randomly taken and included in the survey as part of stakeholders of the groundnut value chain actors. Among supporters of the groundnut value chain, 30 respondents from Haramaya University (15 students and 15 instructors) were included as key informants.

A key informant interview was used to gather primary data on stakeholders' awareness, knowledge and perception using questionnaires. Apt questionnaires for different stakeholders were developed, pre-tested and used in the data collection. Where applicable, the questionnaire survey was conducted at the time of the postharvest groundnut sample collection and stakeholders who provided groundnut samples served as key informants in the interview. The questionnaire was developed after pre-testing through conducting a focused group discussion and interview involving farmers, traders, supporters, village elders, some community leaders and provincial administration staff. The results of the discussion were used to formulate the survey questions and respondents who aware and perceived the situations were selected purposively. These were the criteria I used in inclusion and exclusion of respondents. The questions were designed in a way that each element of the question represented a statement the respondents would have made if asked a question. This was done to minimize respondent bias (Ajzen, 1991).

Four field assistants were selected by the researcher to aid in data collection. They were trained by the researcher to understand the objectives of the study and the purpose and procedure of the interview process; to have a common understanding of the questions in the interview schedule; and to ask the questions to the understanding of the respondents. The field assistants were selected based on their knowledge of the local language, previous research experience and ability to understand and write in the local dialect and English. The instruments were explained to the respondents in their local dialects which include Amharic and Oromifa. Responses were then recorded in English by the field assistants for easy use by the researcher.

2.2. Methods of Data Analysis

Data collected from the questionnaires including socio-demographic characteristics of respondents, awareness of aflatoxin contamination of groundnuts, knowledge on aflatoxigenic fungi and aflatoxin contamination of groundnut, perceptions on indices of groundnut quality, pre- and post-harvest practices of groundnut and associated factors were summarized and analyzed using Statistical Package for Social Sciences (SPSS). Descriptive statistics in the form of frequencies and means were used to analyze the data. Chi-square test was used to explore associations of socio-demographic characteristics with knowledge of fungi and aflatoxin contamination in groundnut at 5% level of significance.

3. Results and Discussion

3.1. Socio-demographic Characteristics of Respondents

The socio-demographic characteristics of the groundnut value chain actors in the study areas have been depicted in Table 1. It was observed that farmers in the study areas had the highest number (70.7%) of male headed households, while the traders had the lowest number (23.3%). Also, the majority of the value chain actors were between the ages of 35 and 50 years old, particularly farmers (61.3%) and traders (53.3%). A significant number of farmers (30.7%) tended to be somewhat younger with nearly below 35 years of age. Most of the value chain actors were married, particularly farmers (54.7%). However, almost a third of farmers (37.3%) were single or unmarried and the remaining (50%) supporters and consumers were single and unmarried.

Table 1. Socio-demographic characteristics of respondents (n=165) (2014).

Variables		Farmers		Traders		Supporters		Consumer	
		N	%	N	%	N	%	N	%
Sex group	Male	53	70.7	7	23.3	18	60.0	13	43.3
	Female	22	29.3	23	76.7	12	40.0	17	56.7
Age group	< 35 years old	23	30.7	11	36.7	9	30.0	11	36.7
	35-50 years old	46	61.3	11	36.7	16	53.3	11	36.7
	>50 years old	6	8.0	8	26.7	5	16.7	8	26.7
Marital status	Single	28	37.3	11	36.7	15	50.0	15	50.0
	Married	41	54.7	12	40.0	15	50.0	15	50.0
	Divorced	6	8.0	6	20.0	0	0.0	0	0.0
	Widowed	0	0.0	1	3.3	0	0.0	0	0.0
Educational level	No formal education	51	68.0	9	30.0	0	0.0	6	20.0
	Primary education	24	32.0	17	56.7	0	0.0	10	33.3
	Secondary education	0	0.0	4	13.3	0	0.0	8	26.7
	Tertiary education	0	0.0	0	0.0	30	100.0	6	20.0
Household income per month (ETB)	< 3000	22	29.3	4	13.3	11	36.7	5	16.7
	3000-10000	46	61.3	11	36.7	10	33.3	15	50.0
	>10000	7	9.3	15	50.0	9	30.0	10	33.3
Years of experience	< 5 years	1	1.3	8	26.7	10	33.3	11	36.7
	5-10 years	10	13.3	11	36.7	16	53.3	11	36.7
	> 10 years	64	85.3	11	36.7	4	13.3	8	26.7

A large number of respondents along the value chain had no formal education, especially 68.0% of the farmers with variable household incomes. In contrast, 32% of farmers, 56.7% of traders and more than 33.3% of consumers had at least attended primary education. However, all supporters had tertiary education. With regard to household incomes, 61.3% of the farmers earned between ETB 3,000 to 10,000 per month. Traders and consumers had the lowest income with 13.3% and 16.7% earning less than ETB 3,000 per month, respectively. With regard to years of experience, 85.3% of the farmers had worked on farming for more than 10 years, whereas most supporters 53.3% had between 5 to 10 years of farm experience.

3.2. Stakeholders' Awareness about Aflatoxin and associated Problems

Awareness about aflatoxin was low among participants and actors of the groundnut value chain (Table 2). The result revealed that almost all farmers (98.7%) and traders (96.7%) were unaware of aflatoxin and its consequences. However, more than 83.3% of the value chain supporters and 53.3% of consumers responded that they had heard the word aflatoxin before. This could be attributed relatively to highest literacy levels of consumer respondents. Awuah *et al.* (2009) reported that up to 90% interviewed farmers, traders, and consumers were unaware of aflatoxin, while 92% of farmers in the Ejura Sekyeredumase district of Ashanti Region (Ghana) had never heard of aflatoxin (Jolly *et al.*, 2006). In the present study, none of the interviewed farmers indicated any knowledge of aflatoxin and its consequences when they were explicitly asked if there were any detrimental health effects accrued from consuming "too much groundnut paste." The aflatoxin concept is not simple because of the abstract nature of the toxin itself and because the timing of the affliction eventually caused by prolonged ingestion being significantly detached from the time of consumption.

The survey results also revealed that farmers (96.0%) and traders (69.9%) were unaware of aflatoxin problem to human and animal health. This could be ascribed to the lack of visual indication (symptoms) on the seeds or nuts as the major factor for their being unaware about aflatoxin contamination. Kaaya and Warren (2005) also reported that a large number of farmers, traders and consumers are not aware of food contamination with aflatoxin.

When respondents were asked about the criteria used to identify aflatoxin contaminated groundnut, some of them pointed out that they could identify spoiled or contaminated crops by the color or the shape; and the common colors claimed were black, brown, white dust and greenish. Respondents also suspect groundnut seeds or pods that are broken or attacked by insect pests would definitely be contaminated by aflatoxin.

Table 2. Awareness of groundnut value chain actors (n=165) about aflatoxin in eastern Ethiopia in 2014.

Questions	Farmers		Traders		Supporters		Consumers	
	Not sure	Sure	Not sure	Sure	Not sure	Sure	Not sure	Sure
1. Have you heard of the word aflatoxins before?	74(98.7)	1(1.3)	29(96.7)	1(3.3)	5(16.7)	25(83.3)	14(46.7)	16(53.3)
2. Are you aware of what produces aflatoxins?	63(84.0)	12(16.0)	27(90.0)	3(10.0)	8(26.7)	22(73.3)	20(66.7)	10(33.3)
3. Are you aware of aflatoxin contamination in groundnut?	62(82.7)	13(17.3)	24(80.0)	6(20.0)	6(20.1)	24(79.9)	21(70.0)	9(30.0)
4. Have you heard of the health effects of aflatoxin before?	72(96.0)	3(4.0)	21(69.9)	9(30.1)	7(23.4)	23(76.6)	15(50.0)	15(50.0)
5. Are you aware of as chronic aflatoxin causes liver cancer?	66(88.0)	9(12.0)	23(76.6)	7(23.4)	11(366.7)	19(63.3)	21(70.0)	9(30.0)
6. Are you aware of as acute aflatoxin cause stunting in children?	73(97.3)	2(2.7)	28(93.3)	2(6.7)	9(30.1)	21(69.9)	20(66.7)	10(33.3)
7. Are you aware of the harmful effects of aflatoxins on animals?	70(93.4)	5(6.6)	22(73.3)	8(26.7)	10(33.4)	20(66.6)	18(60.0)	12(40.0)
8. Are you aware of the harmful effects of aflatoxins on humans?	64(85.4)	11(14.6)	27(90.0)	3(10.0)	9(30.1)	21(69.9)	19(63.3)	11(36.7)

3.3. Stakeholders' Knowledge on Aflatoxin Problem

Responses among participants of the groundnut value chain did not vary with reference to knowledge on aflatoxin problem (Table 3). The result revealed that there was no difference in response between farmers (74.7%) and traders (73.3%) that timing of planting, timely harvesting, drying, thorough sorting, proper storage, use of pesticides and proper cultural practices were not important in reducing the levels of moldiness and aflatoxin in groundnut. There was also no significant difference in responses between farmers (97.3%) and traders (96.7%) in knowledge of long-term exposure to fungi and aflatoxin could not be as such harmful to health. However, 76.6% of supporters responded that the importance of whether timing of planting, timely harvesting, drying, thorough sorting, proper storage, use of pesticides and proper cultural practices reduced the levels of moldiness and aflatoxin in groundnut and long-term exposure to fungi and aflatoxin could be harmful to the health, whereas 50% of consumers responded that the importance of the conditions that describe aflatoxin related issues were important in reducing the levels of moldiness and aflatoxin in groundnut and long-term exposure to fungi and aflatoxin could be harmful to the human health.

Table 3. Knowledge of groundnut value chain actors about aflatoxin problem (n=165) (2014).

Questions	Farmers		Traders		Supporters		Consumers	
	Not imp.	Import.	Not imp.	Import.	Not imp.	Import.	Not imp.	Import.
1.Timing of planting of groundnuts to reduce moldiness	56(74.7)	19(25.3)	22(73.3)	8(26.7)	7(23.4)	23(76.6)	15(50.0)	15(50.0)
2. Timely harvesting to control moldiness of groundnut kernels in storage	55(73.3)	20(26.7)	20(66.7)	10(33.3)	9(30.1)	21(69.9)	19(63.3)	11(36.7)
3.Cultural practices to control moldiness	53(70.7)	22(29.3)	18(60.0)	12(40.0)	6(20.1)	24(79.9)	21(70.0)	9(30.0)
4. Drying groundnuts to reduce moldiness	56(74.7)	19(25.3)	21(70.0)	9(30.0)	8(26.7)	22(73.3)	16(53.3)	14(46.7)
5. Thorough sorting	58(77.3)	17(22.7)	22(73.3)	8(26.7)	10(33.4)	20(66.6)	18(60.0)	12(40.0)
6. Proper storage to reduce AF	47(62.7)	28(37.3)	29(96.7)	1(3.3)	5(16.7)	25(83.3)	12(40.0)	18(60.0)
7. Use of pesticides to reduce moldiness in storage	50(66.7)	25(33.3)	20(66.7)	10(33.3)	7(23.4)	23(76.6)	17(56.7)	13(43.3)
8. Long term exposure to fungi and aflatoxin can be harmful to the health	73(97.3)	2(2.7)	29(96.7)	1(3.3)	6(20.1)	24(79.9)	15(50.0)	15(50.0)

3.4. Socio-Demographic Factors with Knowledge about Fungi and Aflatoxin

The socio-demographic factors affecting the knowledge about fungi and aflatoxin contamination in groundnut have been depicted in a cross-tabulation (Table 4). Being married, educational levels and also household income were the major factors significantly associated with knowledge about fungi and aflatoxin contamination in groundnut. However, gender disparity, age and years of experiences did not affect respondents on the level of knowledge about fungi and aflatoxin contamination in groundnut. Thus, males (12.1%) and females (12.1%) knew equally about fungi and aflatoxin contamination in groundnut. There was no significant difference in the levels of knowledge about fungi and aflatoxin among the three age groups; those individuals with less than 35 years old (6.7%), those persons between 35 and 50 years (9.7%) and those older than 50 years (7.9%) knew about fungi and aflatoxin contamination in groundnut. Moreover, respondents with less than 5 years of experiences (3.0%), those individuals with experiences between 5 and 10 years (13.9%), and those with more than 10 years of experiences (7.3%) knew about fungi and aflatoxin contamination in groundnut.

Table 4. Cross-tabulation of socio-demographic factors with knowledge about fungi and aflatoxin contamination in groundnut (n= 165) in eastern Ethiopia in 2014.

Variables		Do you know fungal and aflatoxin contamination in groundnut?		$\chi 2$
		Yes	No	
1. Sex group	Male	20 (12.1)	71 (43.0)	0.556
	Female	20 (12.1)	54 (32.7)	
2. Age group	< 35 years old	11(6.7)	33 (20.0)	1.190
	35-50 years old	16 (9.7)	61 (36.9)	
	>50 years old	13 (7.9)	31(18.8)	
3. Marital status	Single	40 (24.2)	29 (17.6)	14.461
	Married	40(24.2)*	8 (4.8)*	
	Divorced	6 (3.6)	30 (18.2)	
	Widowed	2 (1.2)	10 (6.1)	
4.Educational level	No formal	60(36.4)	6 (3.6)	15.217
	education	8 (4.8)	10 (6.1)	
	Primary	41(24.8)*	4(2.4)*	
	education	5(3.0)	31(18.7)	
	Secondary			
	education			
	Tertiary			
	education			
5.Household	< 3000 birr	6 (3.6)	36 (21.8)	14.750
income per month	3000-10000 birr	67(40.6)*	15(9.1)*	
	>10000 birr	19 (11.5)	22 (13.3)	
6.Years of practice	< 5 years	5 (3.0)	24 (14.5)	2.690
	5-10 years	23 (13.9)	26 (15.8)	
	>10 years	12 (7.3)	75 (45.5)	

*Note: *Factors significant at p≤0.05.*

In general, it can be assumed that respondents had low level of knowledge about fungal and aflatoxin contamination in groundnut. When analyzed according to factors, respondents who were married, with secondary educational level and with yearly household income level between ETB 3,000 and 10,000 had significantly high total score of knowledge on fungal and aflatoxin contamination in groundnut. The analysis also showed that being single, divorced or widow might contribute to low levels of knowledge among the respondents. Once an individual is tied with a certain type of relationship or married, there would be a possibility that knowledge of some particular diseases would be exchanged between partners, a phenomenon which leads to an increased level of awareness.

Indeed, similar studies have shown the influence of marital status on health promotion and disease prevention. For instance, being divorced resulted in higher odds ratio for poor self-rated health (Kawada and Suzuki, 2011). Besides, a recent study showed that unmarried migrant women were vulnerable to sexual and reproductive health problems due to lower level of knowledge than the married ones (Lu *et al.*, 2012). Although the importance of knowledge in these examples is indirectly explained for health promotion and disease prevention, it could be said that knowledge would be easily accessible through the supports and communications between and among partners.

Education is positively related to awareness, knowledge and perceived benefits (Jolly *et al.*, 2009). It is understood that people with higher education level are likely to be better informed and, therefore, may be better aware of some types of risk of food additives or pesticides in foods than those with less educational levels (Dosman *et al.*, 2001). Additionally, Baker (2003) stated that those with highest levels of education were more willing to pay for food safety. In this study, we found that respondents with higher education status had significantly higher level of knowledge on the occurrence of fungal infections in diets than those with lower education status. This observation clearly depicted that education is an important mode to disperse information and knowledge to the public. In other words, when respondents knew about fungal contamination in groundnut, they were more likely to have knowledge or heard about fungi and/or aflatoxin contamination and its health risk.

Respondents with higher income were more knowledgeable than those with lower income respondents. Inevitably, money appears to matter because it is a marker of something else (Marmot, 2002). For example, Marmot (2002) explained that money and technical knowledge have allowed the community to invest in conditions that favor an alleviation of the conditions that lead to high infant mortality. Besides, income is related to an individual's ability to seek for a better health support as evidences showed that the rich are always getting healthier relative to the poor (Shankardass *et al.*, 2012). In the case of the effects of aflatoxin on human health, those who had better income are more likely to have more access to knowledge than those with lower income status.

Furthermore, fear of lack of information and knowledge about the adverse effects of aflatoxin allows the people to try to access knowledge about food safety from the available experts, who can be expensive or costly. To some extent, the option might be unbearable for individuals with low income status. One of the reasons is the transaction cost in search for knowledge would increase when the symptoms of the problem are not obvious and not well known, and experts and professionals themselves are not totally committed to the problem (Jolly *et al.*, 2009).

3.5. Stakeholders' Perception on the Quality of Groundnut

Perception of groundnut quality among actors of the groundnut value chain has been summarized and tabulated (Table 5). The tabulated indices are conditions necessary for aflatoxin contamination in groundnut and reduction in the quality of groundnut due to contamination by aflatoxin, making them unattractive to buyers and unhealthy for human consumption. The absence of these variables in groundnuts obviously reduces aflatoxin contamination.

From 165 respondents, almost all farmers (89.4%) and majority of traders (83.3%) disagreed on consequences of the eight indices of the groundnut quality, including groundnut with a change in taste (organoleptic), a change in color, moldy growth, broken and bruised nuts, insect-attacked beans, shriveled kernels, stored damp and contained foreign materials (twigs, leaves, dead insects, sand, etc.) as they do promote aflatoxin contamination. This observation is different from the report by Bonner and Nelson (1985) who asserted that high quality of food is most often associated with attributes such as rich/full flavor, taste, freshness, pleasant aroma and looks appetizing. This is because, in this case, the majority of the respondents did not measure the quality of groundnuts on similar parameters. However, according to Holm and Kildevang (1996), individual assessments of quality are personal and situational, and that they are often based on incomplete information about the products they purchase. This may be the reason for this choice by the majority of respondents. Hence, these groups of consumers are, therefore, not likely to be protected from the negative aflatoxin effects through their groundnut consumption habits.

It may be concluded that the majority of farmers and traders are at a great risk of aflatoxin contamination, whereas 83.3% of supporters agreed that all of the eight indices of the groundnut quality, such as groundnuts with a change in taste, a change in color, moldy growth, broken and bruised nuts, insect-attacked beans, shriveled kernels, stored damp and contained foreign materials as they do promote aflatoxin contamination. This group would obviously reject groundnuts which contain one or two of the variables which project the possible presence of aflatoxin in groundnuts. Their perception of groundnut quality would influence their consumption habits and hence would reduce the risk of aflatoxicosis. This group, however, consists of only 83.3% and this shows that the habits of groundnut consumers in the region would largely expose the majority of the respondents to aflatoxin contamination.

The present study is similar with the findings of Harder (2005) who reported factors used to measure the perception of groundnut quality include an increase in the level of aflatoxin contamination and fungal proliferation to a large extent when present in groundnuts. The perception of groundnut quality that consumers generally hold, therefore, plays an important role in their groundnut consumption decisions, which could result in negative health implications some of which include liver cancer, stunted growth, increased prevalence of hepatitis, and low immune strength against HIV infection, among others.

Table 5. Perception of value chain actors (n=165) on the quality of groundnut (2014).

Indices of groundnut quality	Farmers		Traders		Supporters		Consumers	
	Disagree	Agree	Disagree	Agree	Disagree	Agree	Disagree	Agree
1. Groundnuts which have a change in taste promote AF	65(89.4)	10(10.6)	25(83.3)	5(16.7)	6(20.1)	24(79.9)	15(50.0)	15(50.0)
2. Groundnuts which have a change in color promote AF	60(80.0)	15(20.0)	20(66.7)	10(33.3)	8(26.7)	22(73.3)	21(70.0)	9(30.0)
3. Moldy groundnuts promote AF	73(97.3)	2(2.7)	29(96.7)	1(3.3)	9(30.0)	21(70.0)	14(46.7)	16(53.3)
4.Broken and bruised groundnuts promote AF	73(97.3)	2(2.7)	27(90.0)	3(10.0)	13(43.3)	17(56.7)	13(43.3)	17(56.7)
5.Insect-attacked groundnuts promote AF	56(74.7)	19(25.3)	28(93.3)	2(6.7)	5(16.7)	25(83.3)	10(33.3)	20(66.7)
6.Shriveled groundnuts promote AF	73(97.3)	2(2.7)	27(90.0)	3(10.0)	8(26.7)	22(73.3)	12(40.0)	18(60.0)
7.Groundnuts stored damp promote AF	47(62.7)	28(37.3)	29(96.7)	1(3.3)	12(40.0)	18(60.0)	15(50.0)	15(50.0)
8.Groundnuts which contain foreign materials promote AF	74(98.7)	1(1.3)	27(90.0)	3(10.0)	5(16.7)	25(83.3)	13(43.3)	17(56.7)

3.6. Stakeholders' Perception on Pre- and Post-Harvest Practices affecting Aflatoxin Contamination

The perception of farmers and traders on pre-and post-harvest practices that affect aflatoxin contamination has been tabulated (Table 6). About 92% of farmers and 83% of traders dried their groundnut seeds in the open sun. About 86.7% of the farmers and 76.7% of the traders spread the groundnut seeds on the bare ground during drying. As many as 13.3% of farmers spread groundnuts on a raised platform above the ground. All the farmers and traders were involved in storage of groundnuts. About 93.3% of the farmers and 66.7% of the traders stored groundnut in mixture with other crop(s) in previously used structures. According to the respondents, maize was reported to be the number one crop stored with groundnut. All the respondents stored groundnut in rooms dedicated to crop storage. The most commonly used storage material was the polythene sack, which was used by as many as 96.0% of the farmers and 70% of traders. About 73.3% of farmers and 90.0% of traders told that they sorted their groundnut to attract customers or the market. Both farmers and traders mentioned that sorting fetches higher profit and averts health risks. However, the remaining farmers and traders explained that sorting groundnut is not only time consuming but also reduces groundnut quantity by at least 5% on average.

Table 6. Respondents' perception on pre- and post-harvest practices leading to aflatoxin contamination (n=165) (2014).

Questions	Responses	Proportions	
		Farmers	Traders
1. Do you dry nuts?	Yes	69 (92%)	25 (83.3%)
	No	6 (8%)	5 (16.7%)
2. What drying method(s) do you use?	Spread on the ground	65 (86.7%)	23 (76.7%)
	On raised platform	10 (13.3%)	7 (23.3%)
3. Do you store in mixed used structures?	Yes	70 (93.3%)	20 (66.7%)
	No	5 (6.7%)	10 (33.3%)
4. What storage method do you use?	Polythene sacks	72 (96%)	21 (70%)
	Jute sacks	3 (4%)	9 (30%)
5. Do you sort nuts?	Yes	55 (73.3%)	27 (90%)
	No	20 (26.7%)	3 (10%)
6. How do you identify spoiled nuts?	Change in Color	71 (94.6%)	24 (80%)
	Insect Infestation	4 (5.4%)	6 (20%)
7. What do you do to spoiled nuts?	Give to Animals	70 (93.3%)	26 (86.7%)
	Throw Away	5 (6.7%)	4 (13.3%)
8 Does mechanical injury to pods lead to AF contamination?	Yes	35 (46.7%)	10 (33.3%)
	No	40 (53.3%)	20 (66.7%)
9. Does end of season drought for 20 days lead to AF contamination?	Yes	25 (33.3%)	5 (16.7%)
	No	50 (66.7%)	25 (83.3%)
10. Does aflatoxin contamination occur at any time during pre-harvest?	Yes	20 (26.7%)	3 (10%)
	No	55 (73.3%)	27 (90%)

When supply chain actors were asked about the criteria used to identify spoiled groundnut, approximately 94.6% of the farmers and 80.0% of the traders reported a

change in groundnut color as the obvious criteria used. The most common color changes indicated were brown, black and greenish. When supply chain actors were asked about what they usually do to spoiled groundnut, about 93.3% of farmers and 86.7% of traders indicated that they would throw away or dump to garbage. However, 6.5% of farmers and 13.3% of traders told that they process spoiled or molded groundnut into *dawadawa* (a spice used for stews, sauces and soups). Generally, farmers were unaware of the important ways and means of management of pre-harvest and post-harvest aflatoxin contamination of groundnut.

When asked about the mechanical injury on to pods that leads to aflatoxin contamination, about 53.3% of farmers and 66.7% of traders had no appropriate replies to the question. Approximately, 66.7% of farmers and 83.3% of traders disagreed on the point that the end-of-season-drought for more than 20 days leads to aflatoxin contamination. However, this is an important reason for aflatoxin contamination in practice. The farmers' problem of awareness of this fact was due mainly to the lack of visual symptoms of aflatoxin contamination. A similar finding was reported by Kumar *et al.* (2001) who claimed that delayed harvesting was one of the major reasons for post-harvest aflatoxin contamination in groundnut. But, farmers disagreed with this aspect because delayed harvesting was a routine practice for them due to shortage of labor during peak harvest season. Also, 73.3% of farmers and 80.0% of traders replied that aflatoxin contamination does not occur at any time during pre-harvest operation in the field or growth period.

4. Conclusions

The occurrence of aflatoxins in agricultural commodities is a major health concern for livestock and humans. Aflatoxins are potent carcinogenic substance and have also been implicated in human diseases like hepatitis B and tuberculosis and can suppress immune system. Aflatoxins are secondary metabolites of the mycotoxigenic fungi, namely *Aspergillus flavus* and *A. parasiticus*.

In this study, it was observed that awareness about aflatoxin was low among farmers and traders. Moreover, there was no difference in response between farmers and traders that timing of planting, timely harvesting, drying, thorough sorting, proper storage, use of pesticides and proper cultural practices were not important in reducing the levels of moldiness and aflatoxin in groundnut.

There was also no significant difference in responses between farmers and traders in knowledge of long-term exposure to fungi and aflatoxin contamination to be harmful to the human health. Being married, educational levels and also household income were factors significantly associated with knowledge on fungi and aflatoxin contamination in groundnut. Gender disparity, age and years of experience did not affect respondents on the level of knowledge on fungi and aflatoxin contamination in groundnut. From 165 respondents, almost all farmers and the majority of traders disagreed that the eight groundnut quality indices, including change in taste, change in colour, groundnut moldiness, broken and bruised beans, insect-attacked kernels, shriveled kernels, damp stored grains and groundnuts containing foreign materials (twigs, leaves, dead insects, soil, and sand), etc. do not promote aflatoxin contamination.

Farmers and traders were ignorant of the important ways and means of pre- and post-harvest aflatoxin contamination of groundnut. Lack of awareness of farmers was due mainly to lack of visual symptoms of aflatoxin contamination on the groundnut. The findings imply the need for launching a concerted campaign to augment awareness among the farming community, traders, consumers and similar end-users about aflatoxigenic fungi development, aflatoxin generation, contamination and management

and quality maintenance in value chain of groundnut production and marketing. There is a need to explore the possibility of incorporating aflatoxin awareness into routine talk to increase the level of awareness of stakeholders.

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