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Abstract

Food insecurity is a great problem worldwide and Ethiopia is one of the sub-saharan countries that are suffering from poverty and food insecurity and a large part of the population are living in a state of undernourishment. To reduce these problems, a successful horticulture production can be an important factor. Compared to other crops, fruit production in Ethiopia has not been a large part of the agricultural sector. However, the demand on the domestic market is increasing as well as the production for avocado and mango. To increase food security it is important to focus on ways to decrease post-harvest losses of food products and not only have the productivity of agriculture in focus. Food losses after harvest until the food reach the consumer are significant. According to FAO post-harvest losses in developing countries can range from 15 percent up to 50 percent. Avocado and mango are perishable products and therefore sensitive which leads to greater losses than for non-perishable crops. Losses occur in all post-harvest activities such as handling, storage, processing, packaging, transportation and marketing. The losses occur within the whole supply chain due to limited resources such as infrastructure, knowledge, and access to post-harvest technologies. One way to decrease post-harvest losses can be an efficient supply chain management.

The aim of this study is to explore the supply chains and post-harvest losses for mango and avocado in Ethiopia. In order to fulfill the aim a case study was performed of the supply chains for avocado and mango. 30 semi-structured interviews in each supply chain were conducted with actors in; the capital Addis Ababa, Yirga Alem, Wondo Genet and Baco areas. The emperical information was anlyzed using a theoretical framework regarding value chain analysis in developing countries. The framework consists of value chain constraints, value chain analysis and value chain upgrading. Literature regarding fruit supply chains in Ethiopia, handling of avocado and mango and post-harvest losses were also used to analyze the results.

The actors found in the supply chains for avocado and mango are; farmers, brokers, wholesalers, retailers, restaurants and consumers. The only formal horizontal relationship found is an avocado farmers' association. No value adding activities take place on the farmers, brokers or wholesale level. Two retailers and all restaurants sell avocado and mango juice as a value added products. The governance forms are mainly spot-market relationships and hybrid forms of governance. Contracts and agreements are used in the chains but are foremost of informal character. The largest losses of avocado and mango in the supply chains occur during; harvest, transport and storage. These losses can mainly be decreased by implementing; cold chain, improved varieties that are grafted, new harvesting tools where the fruit is collected in a small bag and increased usage of plastic and wooden boxes.

To upgrade the supply chains for mango and avocado the actors desire; more trading partners, improved organization and conditions both at local markets and at the central market. To upgrade the horizontal relationships in the supply chains formation of farmers' cooperative or association or other forms of collaboration are suggested Juice processing are suggested as a way to add more value to the products. Grading system and quality standard are systems that can be implemented in order to increase the quality of mango and avocado and to lower the post-harvest losses in the chains. More formal contracts should be implemented to lower the uncertainty in the chains. Price information is flowing through the chain but do not reach all actors and the information flow between the actors need to be improved.

Sammanfattning

Osäker livsmedelsförsörjning är ett stort problem världen över och Etiopien är ett av de länder som lider av fattigdom och osäker livsmedelsförsörjning och en stor del av befolkningen lever i ett tillstånd av undernäring. För att minska dessa problem kan en framgångsrik hortikultur produktion vara en viktig faktor. Jämfört med andra grödor har fruktproduktion inte varit en stor del av jordbrukssektorn i Etiopien. Dock har efterfrågan på den inhemska marknaden ökat och såväl produktionen av avokado och mango. För att öka livsmedelsförsörjningen är det viktigt att fokusera på sätt att minska förlusterna som uppstår efter skörd och inte enbart ha produktiviteten i fokus. Detta då livsmedelsförluster som uppstår efter skörd är betydande. Enligt FAO kan förluster efter skörd i utvecklingsländer variera från 15-50 procent. Avokado och mango är färskvaror och därmed ömtåliga vilket kan leda till stora förluster. Förluster förekommer i alla aktiviteter efter skörd såsom hantering, lagring, bearbetning, paketering, transport och marknadsföring. Förlusterna uppstår inom hela försörjningskedjan, ofta på grund av begränsade resurser, så som; infrastruktur, kunskap och tillgång till teknologi. Ett sätt att minska förlusterna efter skörd kan vara en effektiv supply chain management.

Syftet med studien är att undersöka försörjningskedjorna för mango och avokado i Etiopien och förluster som uppstår efter skörd i dessa kedjor. För att uppfylla målet utfördes en fallstudie av försörjningskedjorna för avokado och mango. 30 semistrukturerade intervjuer i varje försörjningskedja har genomförts med aktörer i huvudstaden Addis Ababa samt områdena Yirga Alem, Wondo Genet och Baco. Det empiriska materialet analyserades med hjälp av ett teoretiskt ramverk rörande analys av värdekedjor i utvecklingsländer. Ramverket består av tre områden; begränsningar i värdekedjan, analys av värdekedjan samt uppgradering av värdekedjan. För att analysera det empiriska materialet användes även litteratur angående försörjningskedjor av frukt i Etiopien, hantering av avokado och mango samt förluster efter skörd i utvecklingsländer.

Aktörerna som identifierades i försörjningskedjor för avokado och mango är; lantbrukare, broker, grossister, återförsäljare, restauranger och konsumenter. Den enda formella horisontella relationen som hittades är en förening för avokado producenter. Inga värdeskapande aktiviteter sker hos lantbrukarna, brokers eller grossisterna. Två återförsäljare och alla restauranger säljer avokado och mangojuice som mervärdesprodukter. Styrningsformerna inom kedjorna är främst spot-marknadsrelationer och hybridformer. Kontrakt och avtal används i kedjorna men är främst av informell karaktär. De största förlusterna av avokado och mango i kedjorna inträffar under skörd, transport och lagring. Dessa förluster kan i huvudsak minskas genom att; implementera kylkedjor, använda förbättrade trädsorter som är ympade, nya skörderedskap där frukten samlas i en liten påse samt ökad användning av plastlådor och trälådor.

För att uppgradera försörjningskedjorna för mango och avokado önskar aktörerna fler handelspartners, förbättrade förutsättningar och bättre organisation både på de lokala marknaderna samt på den centrala fruktmarknaden. För att uppgradera de horisontella relationerna föreslås bildandet av lantbrukskooperativ eller andra former av samverkan. Juicetillverkning föreslås som ett sätt att öka värde på produkterna. För att uppnå högre kvalitet på frukterna samt för att minska förlusterna efter skörd bör graderingssystem och kvalitetsstandarder införas. Användande av formella avtal i större utsträckning är ett sätt att minska osäkerheten i kedjorna. Prisinformation flödar genom kedjorna men når inte alla aktörer och informationsflödet mellan aktörerna måste förbättras.

Abbreviations

Broker	Traders that meditates between farmers and larger traders
ETB	Ethiopian Birr, 100 ETB ≈ 3.88 EUR
FAO	Food and Agriculture Organization of the United Nations
Izuzu truck	1 truck holds approximately 50 kuntals ≈ 3750 kg
Kuntal	Jute-sack used for packaging of fruit holds approximately 75 kg of fruit.
Offices of Agricultural and Rural development	Local governmental offices that is responsible for development, extension and training services for farmers in their district
Post-harvest losses	Losses of products that occur after harvest
Supply chain	a network of businesses and relationships through which customers receive value-added products, services and information
Value chain	describes the full range of activities which are required to bring a product or service from conception, through the intermediary phases of production, delivery to final consumers, and final disposal after use

Table of Contents

1 Introduction

1.1 Problem background

According to FAO et al. (2012), The State of Food Insecurity in the World 2012, 870 million people were chronically undernourished during the years 2010-2012 and a majority is living in developing countries. The total percentage of people who does not have enough food in the world has declined since 1990 from 18.6 percent to 12.5 percent. In Western Asia, North Africa and Sub-Saharan Africa however an increase in undernourishment has taken place during the last years. In Sub-Saharan Africa 234 million persons, or 26.8 percent, did not have enough food available in 2010-2012 (FAO et al., 2012). Ethiopia is one of the Sub-Saharan African countries that are suffering from poverty and food insecurity as 40 percent of the population were undernourished during the years 2010 – 2012 (www, faostat, 1, 2014).

In order to reduce hunger and malnutrition and promote agricultural growth there is a great demand for investment and progress in the agricultural sector in many developing countries (FAO et al., 2012). Horticulture can be an important factor for economic development and contribute to increased food security and improve the populations' nutrition intake (Weinberger & Lumpkin, 2007). The growing population and changing dietary habits in Ethiopia has increased the demand for fruit (ILRI, 2011). Especially the demand for local fruits with higher quality for example mango, papaya, apple and avocado are emerging. The fruit production in Ethiopia has been small compared to other crops but it has a great potential since the climate is favorable for many horticulture products (Berhel et al., 2010). Two examples of fruits were the production have increased with over 60 percent during the last 10 years in Ethiopia is avocado and mango (www, faostat, 2, 2014; www, faostat, 3, 2014).

Food losses after harvest until the food reach the consumer are significant (www, FAO, 2, 2014). According to FAO (www, FAO, 2, 2014) post-harvest losses in developing countries can range from 15 percent up to 50 percent. Horticultural crops, such as fruits, are perishable products and therefore sensitive which leads to greater losses than for non-perishable crops (Parfitt et al., 2010). To increase food availability it is therefore not enough to increase the productivity in agriculture there is also a need to lower the losses. A problem in the supply chain for fruits in Ethiopia is that the knowledge about post-harvest handling is limited and the post-harvest losses are high (ILRI, 2011; Wakijira, 2010). Losses occur in all post-harvest activities such as handling, storage, processing, packaging, transportation and marketing. Handling and processing of the food are of high importance in order to ensure food-safety reduce losses (Kader, 2003).

In order to define post-harvest losses it is important to do a systematic analysis of the production and handling system and therefore the supply chain for the product (Bell et al., 1999). For tropical food supply chains for products such as mango and avocado there are common features and characteristics (Ruben et al., 2007). There is often large variations in the supply of products and variability in product quality due to different growing seasons, weather changes and production technology used. The production is mostly scattered and undertaken by a large number of small farmers which are producing for local markets with a limited amount of traders. To reach more central markets there is commonly a large number of middlemen between the producers and consumers (Shukla & Jharkharia, 2013).

The access to information, new production technology, credit and external services are constrained in many supply chains in developing countries and the infrastructure are often weak (Trienekens, 2011).

Major causes for food waste are insufficient operational activities within supply chains, such as handling, storage and transportation (Murthy et al., 2009). In food supply chain management the major concerns is post-harvest losses. An efficient supply chain management can therefore be a way to decrease post-harvest losses (Shukla & Jharkharia, 2013). This includes improving and upgrading of all operations and activities in the supply chain (Trienekens, 2011). The focus for supply chains in developing countries is to improve and upgrade processes, quality and distribution. In many developing countries there is a demand for more knowledge about supply chain management and implementation of improved post-harvest technologies (Kitinoja et al., 2011).

1.2 Problem statement

As stated in the previous section there is a great need of increased food security in Ethiopia and the horticulture production can be part of solving this problem. Research also shows that post-harvest losses contribute to undernourishment and food insecurity in developing countries. The losses occur within the whole supply chain due to limited resources such as post-harvest technology, knowledge and infrastructure (Parfitt et al., 2010). The supply chains for horticulture products, such as mango and avocado, are more complex as they are perishable products and depending on climate conditions (Van der Vorst & Beulens, 2002; Salin, 1998). Horticulture can apart from increasing food security also be an opportunity to increase the income for small-holder famers.

In order to increase food security it is not enough to increase the productivity in agriculture but there is also a great need to lower the losses (Parfitt et al., 2010). Horticulture research has historically focused on how to increase the production and little emphasis has been made on how to minimize post-harvest losses (Kitonja et al., 2011). The amount of losses within a supply chain is dependent on activities such as handling, storage, processing, packaging, transportation and marketing (Kader, 2003). It is though not only the activities undertaken by the actors within the chain that affect the performance (Trienekens, 2011). The interactions between the actors and external factors such as governance structures, market access, infrastructure and information flow also have impact on the performance and level of efficiency in a supply chain. In order to improve and upgrade a supply chain, whit emphasis on post-harvest losses, both the activities and factors mentioned above need to be taken into consideration. Upgrading of a supply chain is a way to improve the conditions within the chain and to lower the post-harvest losses. Upgrading can include several areas such as optimization of production processes and activities. Furthermore upgrading can be aiming for the most suitable markets and trading partners within the supply chain. Also the network structure and governance forms in the chain is of importance in order to find upgrading options.

1.3 Aim and delimitations

The aim of this study is to examine the supply chains and post-harvest losses for mango and avocado in Ethiopia. In order to fulfill the aim the supply chains and value chains for mango and avocado in Ethiopia need to be identified. The study addresses the following research questions:

- What are the characteristics of the supply chains for mango and avocado
- What causes the post-harvest losses and where in the supply chains do the largest post-harvest losses occur?
- How can the supply chains for mango and avocado be upgraded in order to reduce post-harvest losses?

1.3.1 Delimitations

The thesis is part of a project and exchange program between the Department of Energy and Technology at SLU and Addis Ababa University, and therefore the study is conducted in Ethiopia. The study areas are delimitated to Addis Ababa, Yirga Alem, Wondo Genet and Baco in Ethiopia. However, to receive a view of the entire country and make sure the practices are not only representative to a specific area, more locations could have been visited. This was not possible in this study, but based on expert opinions from researchers at SLU and Ambo University the areas with high production of the two fruits mango and avocado was chosen as representative for the entire country. These fruits are chosen with guidance from supervisors and researchers at SLU and Ambo University. The two main factors affecting the choice of the fruits were that they are fragile and have a recent increase in domestic supply and demand (pers. com., Chaka, 2, 2014; pers. com., Gebresenbet, 2014).
As Ethiopia is a developing country the literature review and theoretical framework are targeted for this purpose. It can be difficult to use research regarding more developed countries in this study. The study will be delimitated to only identify post-harvest losses, therefore some of the losses that could occur before harvest is not taken into consideration. Post-harvest losses can be measured in varies ways and interviewing is chosen as the method in this study. This means taking part of the actors own perception of the losses and causes of them as the only measure. This measurement is therefore trusted in the respondents' experiences and the results can therefore vary. To measure the losses in other ways could give more accurate results, but valuable information from the actors' viewpoint can instead be lost. In this study only the supply chains that are part of the domestic market in Ethiopia are investigated. Both fruits are though exported from the country to some extend (pers. com., Chaka, 1, 2014). The export market has higher requirements on quality and safety and therefore supply chains targeting export markets are often more developed (Trienekens, 2011). Given the time and resource constraints in the study it was not possible to include both chains, mainly as they differ in the stage of development. It should though be noted that investigating the export market could give opportunities to find upgrading options that could be implemented in the domestic chain.

2. Literature Review

This chapter aims to create a picture of horticultural supply chains in Ethiopia in order to get an understanding of the markets and actors in the chains. Furthermore problems with post-harvest losses in fresh-produce in developing countries are presented. This also includes ways to minimize the losses and cold chain management is described as an effective tool to do this. Facts about avocado and mango and the most proper harvest and post-harvest handling practices are described to obtain knowledge regarding the fruits and handling of the fruits.

2.1 Fruit supply chains in Ethiopia

According to Mulat (2000) the largest constraints in Ethiopian agricultural markets are the limited amount of traders that have a scarce amount of capital together with a large amount of farmers, which leaves the farmers with a weak bargaining power. Furthermore, limited information systems, poor transportation, high handling costs and an underdeveloped sector are other limitations on the market. As fruits are perishable goods it requires even more coordination between the actors within the chain, where transportation and logistics are the key elements (Fernandez-Stark et al., 2011). The horticulture products in Ethiopia are mainly produced by smallholder farms, and a small amount of state-owned farms (Emana & Gebremedhin, 2007).

In a study on the horticultural market in eastern Ethiopia performed by Emana and Gebremedhin (2007), four major levels in the marketing channel were defined; producers, the middlemen/brokers, traders and consumers. There are three types of traders; retailers, wholesalers and exporters. Some of the most important activities within the chain, such as packaging and sorting, are underdeveloped in the area. Other than the added value of the products moving closer to the consumer there is little added value to be recognized. The actor with the most influential role in the market channel for horticultural products in the study area is the brokers (Emana & Gebremedhin, 2007). A large amount of the products sold by farmers go through the brokers and the farmers have a low bargaining power. The farmers and traders rarely have any direct communication with each as the brokers are in between. Since it is the brokers that set the prices, they have high commissions. The farmers are the ones that bear a large share of the costs originated from the brokers. If a farmer refuses to sell for low prices, the brokers merge and boycott the farmer, which leaves them in a place with no other choice than to accept the prices. The limited amount of information in the market chain mostly disadvantages the producers.

A study performed in four regions in southwest Ethiopia investigates the market chain for avocado (Shumeta, 2010). A small amount of the farmers; 4.3 percent, sell their goods in advance where they commit to sell a certain amount of avocados and receive payment before harvest. Approximately half of the interviewed farmers set the price according to the present supply and demand. The rest of the farmers let the buyers set the price. As low as 3.3 percent of the farmers considered quality as a factor affecting the selling price. Shumeta (2010) calculated the gross marketing margin for each actor, which resulted in; producers gain 26.7 percent, collectors gain 25.4 percent, wholesalers in Jima gain 35.4 percent and wholesalers in Addis Ababa gain 12.5 percent.

Shumeta (2010) found that the most common market chain for avocado in the areas investigated was from producer to wholesalers in the city Jima and further on to wholesalers in the capital Addis Ababa. Other actors involved in the chain are the local collectors. They buy avocados from the farmers at a local market and then transport and sell them to

wholesalers. This facilitates the selling for the farmers as they do not have to transport the goods a long distance. Another actor identified by Shumeta (2010) is cafeterias in Jima that sell avocado juice and usually buy the avocado directly from farmers. The prices in the chain fluctuate depending on the season as it affects supply and demand.

Tefera and Alemu (2008) performed a study of the market value chain of fruits in north-east Ethiopia and mainly identified the same actors as Shumeta (2010) and Emana & Gebremedhin (2007); farmers, assemblers, transporters, wholesalers, brokers and processers. The three studies also mutually identified that the farmers have low bargaining power, mostly because of low cooperation between the producers and lack of access to storage facilities. The producers have a low profit share and the price margin for marketing is high (Tefera & Alemu, 2008). This even though the only activities provided by the marketing actors are exchange and transportation of the goods. Warehousing, packaging, grading, transportation among other activities were shown as insufficient in the study. This results in low returns for the actors in the chain and higher consumer prices. Some of the largest challenges in marketing of fruits are lack of transportation facility, standardized measurements, good information flow, market places, improved varieties and undeveloped technology for processing (Tefera & Alemu, 2008). A case study on supply chain for fruits was performed by ILRI (2011) in 7 districts in Ethiopia. The study showed that the small quantities of fruit sold inside the districts are handled by local traders while larger quantities are sold to wholesalers or traders outside the district and often to Addis Ababa.

2.2 Post-harvest losses of fruit in developing countries

Post-harvest losses can be measured both by quality and quantity losses. The losses can appear in any stage of the supply chain during activities such as harvesting, transportation, packing and at market places (Hodges et al., 2011; Kader, 2009).The qualitative losses are foremost due to biological deterioration including water stress, mechanical injuries, respiration rate, compositional changes and many more (Kader, 2004). These are often the effect of environmental factors such as temperature, humidity, sanitary factors and the concentration of ethylene, carbon dioxide and oxygen. The qualitative losses are more complicated to measure, but the quantitative losses are of greater importance to measure in developing countries.

According to Kitinoja et al. (2011) there are three strategies to lower losses of fresh produce; (1) use cultivars that have potential to last long after harvest, together with good flavor and high nutrition, (2) maximizing yield without lowering quality and (3) optimal handling of the product at all post-harvest stages. In developing countries there is a need for better education of producers, improved infrastructure in order for the products to reach the markets, developed value chains, collaboration between actors in supply chains and improved technologies in order to lower the post-harvest losses (Hodges et al., 2011). The level of post-harvest losses in a country has a strong correlation with the available technology and how developed the markets are (Parfitt et al., 2010). To minimize post-harvest losses of fruits and vegetables it is of high importance for the actors to apply suitable post-harvest technology procedures, in order to have long shelf-life and acceptable safety and quality of fruits (Kader, 2004).

Even though fruit and vegetables are produced in high quantities and with acceptable quality the products also need to reach the consumer in an efficient way, or losses will occur (Kader, 2004). This is the case in many developing countries, often due to bad communication between actors and shortage of market information. Another factor contributing to losses of fresh produce is the poor wholesale markets in many developing countries. The facilities for

storage, unloading, loading and packaging are often poor or do not exist at all. Adequate transportation is another essential part of avoiding losses, which is often lacking in developing countries (Kader, 2004). To have access to suitable equipment for harvest and post-harvest practices is important in order to minimize post-harvest losses (Kader, 2004). Knowledge and information regarding how to best handle the fruit to minimize losses are of high importance, but without the proper equipment this is for no use. The access to knowledge, information and equipment are often low in developing countries (Kader, 2004).

Fruits are fragile products and therefore need packaging to protect them from mechanical damage (Thompson & Mitchell, 2002). The packages should also be well ventilated (Hofman et al., 2013). It is important to avoid compression damages on the fruit during storage and transportation (Thompson & Mitchell, 2002). Therefore the packages need to be strong enough to protect the fruit and it is important not to load too much fruit on top of each other. The packages should also hold a weight of maximum 20 kg, as the fruit can be damaged when a heavy box is dropped on top of another. When fruits are transported the main goal should be to have as low amount of losses as possible (Thompson, 2002). In developed countries most transports of perishable goods are cooled. To some extend the transports are also equipped with controlled or modifies atmosphere, as well as equipment that controls humidity and vibration. Many fruits are sensitive to vibration and abrasion during transport, on soft fruit such as ripened mango and avocado the damages can be severe. A way to avoid this is to immobilize the fruit inside the packages and to use smaller packages (Thompson & Mitchell, 2002).

One way to improve shelf-life and avoid chilling injuries of fruits and vegetables is to use heat treatment at 38 ºC for 24 hours up to 72 hours after harvest (Ouma, 2001). The heat treatment is best performed in water, as it transmits heat in a more effective way than air (Fallik, 2004). The length and temperature of the treatment is decided by variety and the environment where the fruit matures (Woolf et al., 1999). Another way of avoiding chilling injuries and increase the quality of the fruit is low temperature conditioning, where the fruit is held just above its lowest tolerated temperature (Woolf et al., 2003). According to Hofman et al. (2013) and Woolf et al. (2003) low temperature conditioning is more effective than heat treatment to prevent chilling injuries and increase the quality of fruits. Surface coating, wax treatment, controlled atmosphere and usage of the gas 1-Methylcyclopropene are used in well developed supply chains for fruit and vegetables to extend the shelf-life (Amarante & Banks, 2001; Thompson, 2010; Feng et al., 2000).

2.2.1 Cold chain for fresh produce

In order to keep the quality of fresh produce and to slow down deterioration of fruit and vegetable it is important to use a cold chain (Kader, 2004; Kader et al., 2004). When a supply chain has a well functioning cold chain the constraints in time can be alleviated and the product value is preserved (Salin & Nayga, 2003). Well-developed cold chain infrastructure decreases losses in both quantity and quality of perishable goods (Kader et al., 2004). The greatest limitations in a cold chain are humidity control, storage, handling and lack of or poor refrigeration (Kader et al., 2004). To maintain a cold chain it is important to cool the product as quick as possible and to always cool it a temperature suitable for the particular product. It is also important to keep the product cooled at the loading and unloading area, as during the transportation. To measure and monitor the temperature of the product during storage and transport is a good way to make sure that the cooling is effective (Kader et al., 2004).

Uncertain power supply, inefficient usage of cool transport and storage and absence of good management are some of the reasons why cold chains often are inadequate in developing

countries (Kader, 2009). A case study conducted by Salin & Nayga (2003) in Thailand and Philippines showed that the main limitations in the cold chain are lack of well functioning cold storage and high distribution costs. According to Kader (2004), important practices for perishable products are too; harvest when it is colder during the day, keep the harvested products in the shade at the field and to keep the products away from sunlight at the market. Even though these practices are of importance for horticulture products the most effective way of ensuring quality and safety is a well developed cold chain (Kader, 2009).

2.3 Avocado

Avocado (Persea americana) originates from Mexico and is cultivated worldwide in tropic and subtropical areas (Shaffer e al., 2013). Avocado is one of the most economically important fruits in the world (Bost et al., 2013). The avocado is divided into three subspecies; Guatemalan, Mexican and West Indian, but the varieties cultivated today are hybrids between these. Avocado fruit has a high nutritional value since it contains several important vitamins, minerals and a great amount of oil (Shaffer e al., 2013). Avocado trees can be seeded or grafted (pers. com., Chaka, 1, 2014). The seeded trees produce fruit after approximately 8 years and grafted trees, being the most common propagation method, produce fruit after only 2 years. Besides the longer juvenile period the seeded trees also have a larger risk of losses in yield and quality. The avocado trees could need irrigation during dry periods but not during rain seasons. Root rot is the most common failure in avocado production and too much irrigation is one of the causes of this. In Ethiopia there are no recommendations for fertilizer application, but the tree can benefit from application in late winter and early summer (pers. com., Chaka, 1, 2014).

Avocado is a climacteric fruit (Hofman et al., 2013). Depending on a fruits ethylene biosynthesis and respiratory pattern during ripening fruits are divided in non-climacteric and climacteric groups (Singh et al., 2013). A climacteric fruit will reach maturity when it is attached to the tree but the ripening phase of the fruit starts when the fruit is harvested (Brecht et al., 2009). To delay the ripening process it is of importance to lower the temperature, eliminate mechanical damage and reduce ethylene production (Yahia, 2011). The ripening phase is essential for the eating quality but the post-harvest life of the fruit is shortened as soon as the ripening starts. Ripening of climacteric fruits can be started artificially by several external means (Gamage & Rehman, 1999).

Anthracnose, Dothiorella/Colletotrichum fruit rot complex and stem-end rots are the most severe post-harvest diseases on avocado (Barkai-Golan, 2001; Van Dyk et al., 1997). Anthracnose is initiated by fungus and is often controlled by fungicides (Pegg et al., 2002). Orchard hygiene and field sanitation by removing dropped fruit on the ground and dead wood and leaves from the tree are important ways to control anthracnose (Hartill et al., 1991). Cultivars and rootstocks differ in their sensitivity to anthracnose and therefore it is important to have this in mind when making these choices (Willingham et al., 2001; pers. com., Chaka, 1, 2014). Stem-end rot is known in all areas where avocado is produced but is not as important as anthracnose (Pegg et al., 2002). The disease spreads by contact and therefore whole boxes of fruit can easily be infected.

2.3.1 Harvest and post-harvest handling

It is of high importance to have good harvest and post-harvest practices and knowledge about post-harvest physiology of avocado in order to keep good fruit quality (Hofman et al., 2013). Furthermore it is important with efficient practices since the harvest and post-harvest phase counts for almost 60 percent of the costs in production and marketing for avocado.

Avocado is harvested manually by clipping or plucking (Hofman et al., 2013). The clipping is conducted with a picking pole or secateurs. If the fruit is plucked it is pulled from the tree, which leads to a scar where the stem used to be situated. The clipping takes longer time than plucking and the clipper needs to be cleaned to prevent diseases from spreading. Some varieties of avocado is not suited for plucking as it can damage the skin, but on the other hand clipping leaves the stem on the fruit which can cause injuries on the fruit during harvesting, transport and packing. In Ethiopia the harvesting of avocado is conducted in different ways depending on if the fruit tree is seeded or grafted (pers. com., Chaka, 1, 2014). The grafted trees are smaller and the fruits can therefore easily be plucked, whilst the seedlings are taller and the fruits are clipped with picking poles (Hofman et al., 2013). In Ethiopia it is common that the fruits that are clipped are dropped to the ground and then collected, which can cause mechanical damage on the fruit (pers. com., Chaka, 1, 2014). The farmers are therefore recommended to use baskets to collect the fruits from the tree.

In order to decide when to harvest the avocado it is important to find the minimum maturity, in other words; how early the harvest can be conducted and still be sure that the fruit will ripen to an acceptable eating stage (Hofman et al., 2013). Two ways of measuring the minimum maturity are oil concentration and dry matter, which has high correlation with each other (Ranney, 1991; Hofman et al., 2013). There can though be large variations between fruits even on the same tree, so this can only be used as a guideline (Hofman et al., 2013). The time of harvest can be affected by market prices, as the prices drop during peak seasons (Hofman et al., 2013). Therefore there can be a wish to harvest the fruit early or leave the fruit on the tree after it has reached its physiological maturity. Early harvest can though come with a risk of lower quality and late harvest can increase the risk for diseases and the ripening period is often shortened (Hofman et al., 2013).

When harvesting avocado it should be acknowledged that the time of the day can affect the fruits (Hofman et al., 2013). If the harvest is conducted early in the morning the fruits are less exposed to the sun when they are left on the field. But if fruits are harvested when they are wet, only 5 mm rain one day before harvest is needed, and the risk of quality losses in the future increases (Duvenhage, 1993). If the fruit is harvested in temperatures above 30 ºC the ripening can proceed quicker and therefore often less diseases occurs (Arpaia et al., 1992). But if the fruits have temperatures above 30 ºC before cooling the risk of flesh disorders and rots can increase.

After harvesting it is important to keep the avocados in the shade, otherwise the sunlight can cause dehydration and sunburn on the fruits. It is better to have leaves to cover the bins instead of paper or space blanket as it provides the fruit with air (Arpaia et al., 1992). Within two hours after harvest the fruit should be transported to packing-houses (Hardy et al., 1995). When the avocado is transported from the field the vibration should be minimized and bouncing of the fruits should be avoided (Hofman et al., 2013). The largest reason for damage of the fruits during transportation is contact with the bin that they are packaged in (Zauberman et al., 1969). Therefore the damages are reduced when the fruit is transported in bulk bins or when the bulk is dressed with canvas. The mode used for transport should also have good suspension.

The storage life of avocado can differ from 4 to 26 days (Smith et al., 1992). As previously mentioned the maturity of the fruit when harvested can be a contributing factor, as the ripening period is shortened if the fruit is more mature (Hofman et al., 2013). It should though be noted that fruits that ripen faster have less rotting problems (Hopkirk et al., 1994). Mechanical damages on the avocado during harvesting and packaging can be revealed several days after the impact. The fruit can be cleaned from field residues with only water or together

with brushing. If brushes are used it is important to be careful when choosing type and impact from the brushes as it can cause mechanical damage on some avocado varieties. Insecticides and fungicides can be applied after the cleaning. After packaging it is important to cool the avocados as fast as possible, preferably within 6 hours after harvest (Arpaia et al., 1992). This action is the most important part of the cold chain to insure the possibility of long-term storage (Kok et al., 2010). It is also important that the cooling is uniform and rapid. The optimal temperature for longer storage is 4-7 ºC. The difficulty with cooling of avocado is to hold back the natural fruit deterioration but not cause any cooling injuries.

2.4 Mango

The fruit Mango (Magnifera indica L.) originates from south Asia and is cultivated in tropic and subtropical areas in over 90 countries (Crane et al. 2009). A common variety worldwide is "Tommy Atkins" and is also grown in Ethiopia (Yeshitela et al., 2005). Other varieties grown in Ethiopia are Kent, Keit and Apple mango (ILRI, 2011). Mango is called "the king of fruits" because of its flavor, delicacy and nutritional contents and in the tropical horticulture production it is considered as the second most important fruit crop (Singh et al., 2013). Mango fruit contains a fair source of phosphorus and potassium, and a good source of vitamins A, C, B-6, and E (pers. com., Chaka, 1, 2014). Furthermore Mango fruit is an important part of people's diet in several developing countries (Crane et al., 2009).

A mango tree bear fruit within three to six years after planted depending on chosen propagation method (Singh et al., 2013). Grafted trees bear fruit earlier and are smaller in size. A bearing mango tree is draught tolerant but young trees requires irrigation. Fruit producing mango trees should be fertilized in order to promote healthy growth flushes and flower production. The producer should though be careful not to over fertilize as it can cause problems such as reduced flowering and fruit yields (Crane et al., 2009). Mango belongs to the climacteric group of fruits therefore the maturing and ripening phases are the same as for avocado (Singh et al., 2013). For further information about climacteric fruits see section 2.2 Avocado.

In Ethiopia anthracnose and stem- end rot are important post-harvest diseases in mango production. Anthracnose is caused by fungus and appears both as a pre-harvest and a post-harvest disease (Prusky et al., 2009). It is the most severe disease in mango production worldwide and cause large losses. Stem- end rot is another severe disease that causes problems in the mango supply chain (Prusky et al., 2009). The symptoms of anthracnose and stem- end rot are similar in avocado and mango production. Furthermore the ways to treat and prevent the disease are comparable, see subsection 2.2.1. Diseases and pests affecting post-harvest avocado. One of the most important pests in mango production and post-harvest handling are fruit flies. The larva of the fruit fly infests and feed on the fruits and cause significant losses (Pena et al., 2009). Fruit flies are a large problem in mango production in Ethiopia (pers. com., Chaka, 1, 2014). To remove the fruit flies and other insects from the fruit different types of post-harvest treatments are used such as chemical treatments, low and high temperature treatment, controlled atmospheres or a combination of these (Yahia, 1998).

2.4.1 Harvest and post-harvest handling

In order to maintain and develop a high quality of mango it is significant with good harvest and post-harvest handling (Brecht et al., 2009). This requires knowledge about post-harvest physiology of mango to determine the most appropriate handling practices. Harvesting of mango fruits is conducted by hand in several countries (Crane et al., 2009). This is a large

cost in mango production since all the fruit do not mature at the same time and therefore one tree requires to be harvested more than one time. Furthermore the large tree canopies and the inefficient supply of tree-size-controlling rootstocks also affect the harvest practices. The multiple picking requirements are one factor contributing to the difficulty to mechanize the harvesting practices. Other problems in mechanizing harvest of mango are the difficulty to determine the maturity of the fruit and that different cultivars have various colors, weight and size. In Ethiopia practices for harvesting mango differs but a common practice is hand picking from the ground, climbing the tree or using a ladder. Other ways to harvest mango in Ethiopia is using a long stick or scissors to cut the fruit from the tree (Hussen & Yimer, 2013).

It is important to harvest mango fruits at a suitable stage of maturity since this determines the quality of the fruit and its durability (Yahia, 1998). If the fruits are harvested in an immature stage, the mangoes are more susceptible to chilling injuries when kept in a cold storage and the fruit may not ripen properly. Over mature fruit is sensitive to mechanical damages such as water loss, decay and bruising which deteriorate the quality. The final decision when to begin the harvest is determined by factors such as labor availability, market demand, consumer preferences and shipping time and schedule if shipping of the fruit is required (Yahia, 2011).

It is desirable that the fruits are harvested during the cooler parts of the day to reduce the risk of heat injury and sunburn (Yahia, 2011). This also reduces the costs for cooling the fruits. It is important that the fruits are handled gently; rough handling can lead to internal fractures, bruises or skin injuries on the fruit. As mentioned above harvesting is conducted by hand in most countries; fruits from the lower part of the tree can be harvested by hand while a picking pole is used for the fruits higher up in the tree (Crane et al., 2009). Pickers reach the fruit by climbing the trees or using ladders or hydraulic lifts. The fruit should never fall straight to the ground and therefore the picking pools should have attached baskets or bags or other attachment by which the picker can grip the fruit stem (Yahia, 2011). The fruit is harvested at different stages of maturity depending on how far the fruit will be transported, how long it will be kept in storage and the requirements for the specific market (Crane et al., 2009).

When the stem is taken away from a mango fruit, latex sap spurts out from the cut stem. The latex sap has high oil content and low pH and can cause peel damage on the fruit (Johnson & Hofman, 2009). However, the latex may protect the fruit against diseases and fruit fly infestation. It depends on the cultivar how sensitive the fruit peel is to the sap and the concentration of latex also differs among the cultivars. To prevent peel damages, so called sapburn, from the latex sap 10-20 mm of the stem can be left on the fruit during harvest. Another practice to prevent sapburn is to drain the latex sap from the fruit and dip it into alkaline detergents.

After harvest the fruit should not be exposed to sunlight (Johnson & Hofman, 2009). The fruit should be kept in the shade or removed from the field to a pack house as soon as possible. The roads to the pack house should be smooth to prevent mechanical damages on the fruit caused by vibration and bouncing. At the pack house the procedures can differ. According to Johnson & Hofman (2009) the mangoes should be washed and then undergo a hot water treatment. Furthermore fungicides can be applied to prevent diseases. After this the fruits are graded and disinfested against pests before the fruits are packed. After packing it is important to cool the mangoes as soon as possible. An effective and uninterrupted cold-chain is of high importance to delay the ripening and to extend the shelf-life of mango (Prusky et al., 2009). Mango is sensitive to chilling injuries so it is important that the fruits are not stored a longer period under 13 º C (Singh et al., 2013). Storage life of mango differs depending on handling of the fruit and storage temperature. If the fruits are stored airy at a temperature at 10 °C−15 °C the storage life can be up to 2-3 weeks but it is often shorter (Yahia, 1998).

3 Theoretical Framework

The theoretical framework in this thesis is based on Trienekens (2011) value chain analysis for developing countries. The framework consists of three different components as seen in Figure 1. The first part is value chain constraints and includes market access, infrastructure and resources and institutional voids. The second part of the framework is value chain analysis where three elements of a value chains are analyzed; network structure, value added and governance structure. The last part includes value chain upgrading where upgrading options of the three elements are identified. Trienekens framework is adapted to suit the aims of the thesis.

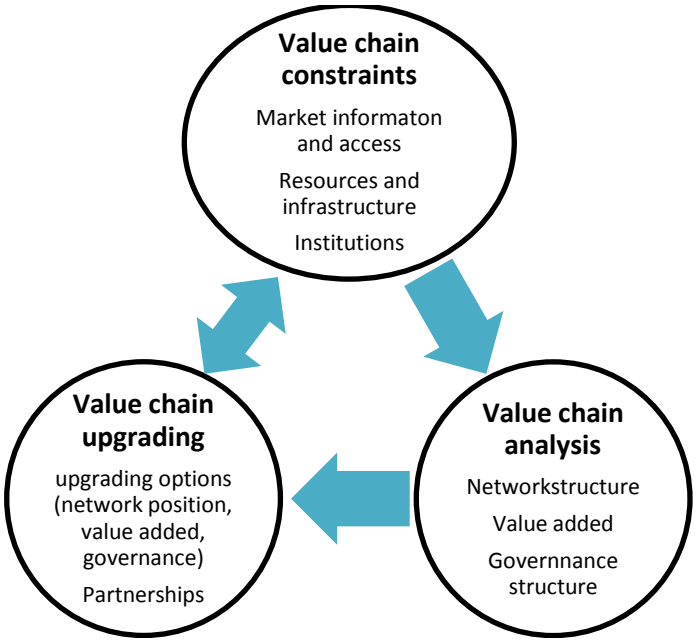

Figure 1. Value chain analysis framework, figure adapted from (Trienekens, 2011).

Trienekens (2011) framework is derived from literature regarding value chains in developing countries and four theoretical "streams" with different views on intercompany relationships. The four theoretical perspectives are global value chain analysis, supply chain management, new institutional economics and social network theory.

The term value chain can be defined as "a value chain describes the full range of activities which are required to bring a product or service from conception, through the intermediary phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use" (Kaplinsky, 2000, p.121). The performances of the chain activities are important. How and where value is created in the chain and how the value is shared among the actors is also significant. In global value chain analysis the focus lays on the lead firm's position in value chains and its relationships with other actors (Trienekens, 2011). Key concepts in this theoretical field are information asymmetry and power relationships between producers in developing countries and multinational companies or markets in Western countries (Gereffi et al., 2005). Global value chain analysis focus on how actors, especially in developing countries, can upgrade their activities in order to participate in global value chains and which barriers exist to entry these chains (Kaplinsky, 2000; Gibbon, 2001). Governance has a large impact in value chains and is an important part of the theoretical stream regarding global value chains (Gereffi et al., 2005). In this thesis focus lays on the national supply chains for

avocado and mango in Ethiopia; therefore the parts of the theory regarding the global perspective are not relevant. However, the parts regarding governance and upgrading options are central for the analysis.

The second theoretical perspective is supply chain management and includes management of operations and activities in value chains (Trienekens, 2011). A good supply chain management requires to maximize the value within the supply chain and to manage the costs generated from the flow of products and information in the chain in a proper way (Chopra & Meindl, 2013). Supply chain management can be defined in different ways, Lambert & Cooper (2000, p. 70) refer to it as "Supply Chain Management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders". The aim is to balance the supply and demand throughout the supply chain from the producer to the end-consumer.

To have a successful supply chain information sharing and coordination between the actors are crucial parts. For supply chains in developing countries the focus in supply chain management is to improve quality and processes and to optimize distribution processes (Trienekens, 2011). The supply chain for food differs compared to other types of products since many food products are perishable goods and therefore have specific storage and transportation requirements and high demand and price fluctuations (Hobbs & Young, 2000; Van der Vorst & Beulens, 2002). In food supply chain management the major concerns is post-harvest losses (Shukla & Jharkharia, 2013).

From the third theoretical perspective, new institutional economics, Trienekens (2011) uses agency theory and transaction cost economics (TCE) in his framework to analyze the organization and governance of transactions between actors in the value chain. Transaction costs can be defined as "Transactions costs are the negotiating, monitoring and enforcement costs that have to be borne to allow an exchange between two parties to take place" (Jones & Hill, 1988, p.106). Governance has a central role and firms should aim for governance forms that minimize the transaction costs (Williamson, 1999). Value chain actors use monitoring systems, contracts and joint investment in order to prevent opportunistic behavior (Trienekens, 2011). In agency theory "one party (the principal) delegates work to another (the agent), who performs that work" (Eisenhardt 1989, p., 58). The focus in this theoretical field is to determine the most efficient contract and governance structures for the principal- agent relationship. The main issues in this are how to measure the performance of the parties and decide which party that will bear most of the risks (Trienekens, 2011). New institutional economics can be used to determine which contracts or agreements that are the best for producers and value chain actors in developing countries. In these chains the business environments are often uncertain with a high level of opportunistic behavior from the actors involved and have week enforcement regimes and institutions (Ruben et al., 2007).

The last theoretical field used in the framework is social network theory, where the focus is inter-relationships between social and economic interactions in value chain networks with vertical and horizontal relationships between the actors (Trienekens, 2011). In this field the belief is "that economic actions are influenced by the social context in which they are embedded and that actions can be influenced by the position of actors in social networks" (Gulati, 1998, p.295). Not only economic factors have impact on relationships between companies but also trust, power, mutual dependence and reputation plays a great role (Uzzi, 1997). With strong network relations the social capital can increase and transaction costs decrease as well as market access can be improved (Gulati, 1998; Trienekens, 2011).

3.1 Value chain constraints

3.1.1 Market access

The market for food in developing countries can be categorized as three different sub-systems with differing market channels and a differentiation in safety and quality demands (Ruben et al., 2007); A- B- and C-systems. The A-system usually exists of small-scale producers that distributes to a local market and is a low-income chain (Ruben et al., 2007). Even though the system aims at a local market they can often be part of other market system, usually through middlemen. This often makes them part of a long chain where the added value is shared by a large number of actors, the distances are long and the primary actors have limited market information. Even though the A-systems often contribute a large quantity of agriculture produce in developing countries the value is fairly low (Ruben et al., 2007).
The B-system mainly targets supermarkets and is a local chain with middle to high income (Ruben et al., 2007). The producers in these chains are often small or medium scale and are tied to each other in cooperatives, associations or other types of contracts. The quantities delivered by the B-systems are in general smaller than what is provided by the A-system, but still generate larger value. They also live up to national and in some cases international safety and quality standards for retailers to a larger extend compared to the A-system (Ruben et al., 2007). The C-system is mainly concentrated on export, but the products that are unsuitable for export is targeted to the national market (Ruben et al., 2007). The C-systems are integrated to a greater extent than the two other systems and exists of fewer actors. Another characteristic of the C-system is that it provides a small quantity of produce compared to the other chains but with higher added value (Ruben et al., 2007).

In order for an individual actor or a chain to achieve market access it is essential with market knowledge and market orientation. Market orientation of a value chain is defined by Grunert et al (2005) as "chain members' generation of intelligence pertaining to current and future end-user needs, dissemination of this intelligence across chain members, and chain wide responsiveness to it". To clarify; this definition includes all undertakings of the actors in the chain concerning information about the end-consumer, all information exchange between the actors regarding the end-consumers and last activities by the actors with the goal to create added value for the end-consumer. How market oriented one actor in the chain is affects the rest of the actors, therefore the entire chain is affected by how well one actor serves the demand of the end-consumer.

3.1.2 Infrastructure and resources

According to Trienekens (2011) there are four main constraints regarding resources and infrastructure faced by markets in developing countries. The first constraint regards little access to input resources, in other words physical resources. The second constraint is the geographic position of many producers where they face long distances to central and valuable markets. Thirdly, lack of human resources in form of educated labor and knowledge is a restraint for markets to advance in developing countries. The last constrain concerns lack of technology, both for production and distribution purposes. Besides from these four constraints there is a lack of adequate infrastructure, both regarding information and distribution. Products distributed in an efficient way and information flow are elementary conditions for a chain to develop.

Trienekens is not alone in saying that infrastructure is a definite constrain for markets and supply chains in developing countries (Viswanadham, 2006; Shukla & Jharkharia, 2013;

Barrett & Mutambatsere, 2005). The inadequate infrastructure for transportation, cold-storage and processing are some of the greatest reasons for waste in the agri-fresh supply chains in developing countries (Viswanadham, 2006; Shukla & Jharkharia, 2013). Besides from these infrastructure problems the lack of information infrastructure is a constraint for the possibility of upgrading the supply and value chains in developing countries (Shukla & Jharkharia, 2013). One of the greatest problems regarding this is the large gap of information about consumers demand to the producers, which results in difficulties to match supply and demand in the chain.

In supply chains in developing countries, it is common with a large number of middlemen, which can complement the undeveloped infrastructure, but at the same time be a high cost for the chain (De Boer & Pandey, 1997). Local food systems, which represents many food systems in developing countries, often has inefficient distribution infrastructure (Gebresenbet & Techane 2012). This is often signified by distribution that is not centralized and high transportation cost per unit. Many famers in developing countries living in the rural areas are constrained in their distribution of products by inadequate transportation infrastructure. Other than the distribution it is important in these areas to focus on developing the collection, storage, packaging and distribution of agriculture products (Gebresenbet & Techane 2012).

3.1.3 Institutional Voids

World Bank (2002, p. 6) define institutions as; ”rules, enforcement mechanisms, and organizations”. They further state that institutions is not only rules, but also behavior, and that it is both rules between actors and organizations that are used to obtain the desired outcome. Institutions are central both for markets to exist and for them to be well functioning (Mair & Marti, 2009). Institutions can be both public or private and formal or informal (World Bank, 2002). Examples of public institutions are tax collection agencies and the judiciary. Private institutions on the other hand are for example relationships between community members and banks. Formal institutions are laws implemented by governments, rules that private institutions have adopted, private organizations and public organizations. Informal institutions are not part of the formal legal system as it is often not written down but are formulated as codes of conducts. In order for markets to exist and be well functioning there is a need for both formal and informal institutions. The need for informal institutions is greater in poor countries as the formal institutions are not as well functioning as in more developed countries.

Mair and Marti (2009, p. 422) define the institutional voids in developing countries as “situations where institutional arrangements that support markets are absent, weak or fail to accomplish the role expected of them”. While a supporting government is essential for development (Murphy, 2007), government structures are often corrupt or weak in developing countries with conditions on the markets that are favorable for some actors, nepotism, over taxation and short time horizons (Mair & Marti, 2009; World Bank, 2002). Scientists from different fields (McDermott, 2002; Stark, 1996; Fligstein & Mara- Drita, 1996; North, 1991) have agreed over years that it is the government in a country that is responsible for building and maintaining institutions. But when governments cannot live up to these expectations it is instead assumed that private business groups step in (Khanna & Rivkin, 2001; World Bank, 2002). Business groups are though only willing to fill these voids as long as it gives profitability. Therefore a lack of institutions can appear when there is no direct profit for business groups and the government fails to fulfill their expected tasks.

3.2 Value Chain Analysis

3.2.1 Network structure

Network structure is essential in the analysis of value chains since it describes the relationships and connections in the value chain (Trienekens, 2011). In order to analyze the network structure it is of importance to investigate both the vertical and horizontal ties in the value chain. The vertical ties in the network shows the flow of services and products in the supply chain/value chain from the primary producer to the end- consumer. The ties can follow all steps in the value chain or skip one or more steps, for example a straight tie between a farmer and a retailer. The horizontal ties in the network shows the relationships between actors operating on the same level in the chain. These relationships can have various structures such as price agreements among traders or/and farmer cooperatives. A strong collaboration and information exchange in the horizontal ties enable and stimulate market access and market information as well as the exchange of information through the vertical connections in the value chain.

To perform an analysis of a network structure focusing both on vertical and horizontal connections in a value chain, Lazzarini et al. (2001) developed "netchain analysis". In this concept both network and supply chain perspectives are used to investigate the inter-organizational collaborations (focusing on the coordination mechanism sources and value creation) between actors in a network. In supply chain analysis the focus lays on vertical transactions between the actors in the supply chain, such as logistics management or contractual arrangements (Lazarrini et al., 2001). Network analysis emphasizes the horizontal relations between actors in a network and evaluates knowledge transfer and social attachments. In netchain analysis focus lays on mapping out actors on each level of the chain and their relations to actors on the same level and their connections to actors on other levels. The analysis is used in order to analyze both horizontal and vertical ties in a chain.

The network structure in a value chain is dependent on what market channel (s) the actors have chosen (Trienekens, 2011). Trienekens (2011, p. 61) defines marketing channel as following: "A marketing channel bridges the gap between producers and market and may be defined as a value chain or supply chain forming a "channel" for products and services that are intended for sale at a certain market". Available market channels through which a firm can sell their products or services depend on the limitations to get market access. It can be limitations in forms of; poor supporting infrastructures in order to reach markets, no or limited access to price and demand information and limited information about what quality of the products or services the customers demand. The specific characteristics of the markets affect firms' ability to take part in different market channels. Furthermore the producer knowledge of market demands and what kind of technologies the producer has access to also have impact on the firms' market channel choices. In many developing countries horticultural producers do not have access to well function market channels which results in losses of their products (Kader, 2004).

3.2.2 Value Added

Value is created in the chain by different actors at different stages and is related to costs, quality, innovativeness, delivery time and delivery flexibility etc. (Trienekens, 2011). Ruben et al. (2007, p. 34) define value added as " the difference between the selling price of output(s) and the purchase price of inputs, including the transformation and transaction costs involved in sourcing and selling". How the value added is distributed within the chain

depends on what comparative advantages each agent possess in the chain, including the bargaining conditions and the internal governance in the value chain have impact (Lazzarini et al., 2001). Other factors such as production technology and information asymmetry between actors and stages in the chain also influence where the value added occurs (Trienekens, 2011). The size of value added is determined by which actors that have competitive advantages within the value chain network. Furthermore the size of value added is dependent on the end-customer's willingness to pay.

What opportunities a firm has to add value on their products and services depend on factors such as the chain actors' technological capabilities and market characteristics (Trienekens, 2011). The aim for all firms is to produce products and services at the right value for the right market and for this to be achieved market information regarding process and product requirements plays a great role. To find value adding opportunities a firm has to search both the possibilities to relax and improve market access constraints that they face in existing markets and for opportunities to address new markets.

Safety and quality of the products are in focus in value adding processes in food chains (Trienekens, 2011). Quality of a product can be measured by the color, taste and tenderness etc. or by characteristics of the product process such as fair trade or organic production. The perishability of many food products has impact on the quality and shelf-life and the risk of quality degradation is high. Therefore there are several aspects influencing quality of the product and production processes (Trienekens & Zuurbier, 2008). Figure 2 shows different steps in a fruit chain and factors that can influence the quality of the product.

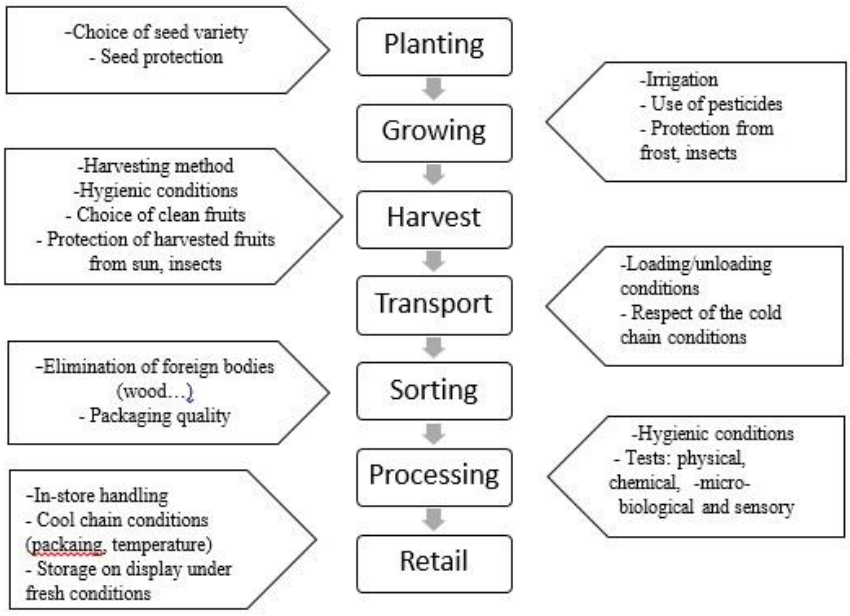

Figure 2. Factors affecting quality in a fruit supply chain, adapted from (Trienekens & Zuurbier 2008).

The first activities in Figure 2 are planting and growing factors where it is important to choose suitable varieties of seeds and protect the plants (Trienekens & Zuurbier 2008). Furthermore the producer should use irrigation and pesticides if needed. The weather conditions, seasonality and biological variation also have impact on the quality of the fruits. Harvest is an important activity and losses of fruit occur due to poor harvesting and handling techniques (Kitonja et al, 2010). The next activities transport, logistic conditions and storage also have a large impact on the quality and durability of fruits (Ruben et al., 2007). In some cases 25 percent of the total value of production can be lost due to losses during production, processing and transport.

The next step in the chain is sorting of the fruits which needs to be performed in a good way in order to achieve high quality of the products. A problem for unprocessed food products is that there can be a difference between the end-consumers demand and what is provided by the initial producer (Ruben et al., 2007). By sorting the products based on commonly used and relevant grading systems this problem can be reduced. More detailed sorting can also affect the value added distribution between the actors and local producers may be able to increase their share by selling to different consumer categories and markets, with various demands. The last step in the supply chain is the retailing and here it is important with a proper store handling of the fruits, good storage and cold chain conditions (Trienekens & Zuurbier, 2008). Also on this level losses of fruit occur due to rough handling, poor packaging and lack of knowledge (Kitonja et al, 2010).

3.2.3 Governance structure

Firms and actors in a value chain are linked together by different types of contracting and sourcing relationships, in other words different forms of governance (Gereffi et al., 2001). Governance can be defined as "authority and power relationships that determine how financial, material and human resources are allocated and flow within a chain" (Gereffi, 1994, p. 97). Regarding governance of value chains in developing countries, Trienekens (2011) addresses two main perspectives in the framework, the transaction cost perspective and the global value chain perspective. In transaction cost theory the focus lays on the governance of transactions that take part in vertical relationships between firms (Williamson, 1999). From the global value chain perspective it is the power relationships in the chain that are of interest, focusing on the "lead-firm's" position in the chain and consequences regarding the distribution of value added (Gibbon et al., 2008). In this study most emphasis lays on the transaction cost perspective.

The transactions between the actors in the chain are driven by opportunism and bounded rationality of the actors. The governance structures in a chain can be explained by the characteristics of transactions taking part in the value chain (Trienekens, 2011). Ruben et al. (2007) points out ex-ante transaction costs and ex-post transaction costs. Ex-ante costs are costs that occur before the transaction take place such as transaction costs for bargaining, searching for potential exchange agents and screening of potential agents. Ex-post costs are costs that occur during or after the transaction takes place such as transaction costs for transferring of property rights and monitoring contracts.

Williamson (1999) describes three general types of governance forms; spot market (''arms-length'') relationship, hybrid governance forms (e.g. contract) and vertical (organizational) integration or hierarchy. If transaction costs are high, actors will prefer integration or contracting to lower the transaction costs. If transaction costs instead are low, actors will prefer market governance. Information asymmetry between actors, cultural and social elements also have impact on the choice of governance forms (Ruben et al., 2007).

Furthermore, in developing countries there are several factors which have impact on governance structures (Trienekens & Willems, 2007; Trienekens, 2011). In many cases there is a high level of uncertainty in the business relationships in the chain due to; poor physical infrastructures (roads, telecommunication, cooling and storage facilities), unbalanced trade relationships (opportunistic buyer behavior, dependencies) as well as unfavorable political and social conditions. In many value chains in developing countries, written contracts are not used in a larger extent (Ruben et al., 2007). Instead relational contracts are used where trust and reputation plays a great role in order to keep transaction cost low and to prevent opportunistic behavior. Perishable products such as vegetables and fruit are associated with

higher risk and uncertainty compared to non-perishable products (Ruben et al., 2007). With these characteristics more "central" governance is needed to fulfill the actors' objective in supply the chain.

Information exchange between the actors in the chain regarding for example characteristics of the service or product and delivery conditions need to be efficient (Trienekens & Willems, 2007). Unfortunately the information exchange is constrained in many cases due to poor communication infrastructures, information asymmetries between the actors in the chain and unclear structures of the market channels. In many developing countries the great number of intermediaries in supply chains for fresh produce is also a problem for the information exchange (Shukla & Jharkharia, 2013).The information between producers and consumers becomes hampered. These problems cause post-harvest losses in supply chains for fresh produce, especially due to poor information exchange regarding demand in the chain. The lack of information leads to difficulties for producer to react to changes in consumer demand.

3.3 Upgrading options

3.3.1 Upgrading of network Structure

In order to upgrade network structures in value chains it is essential for actor's to aim for the right market and to take part in the right market channel (Trienekens, 2011). It can be difficult especially for small producers in developing countries to change market channel and therefore it is desirable to look for accessible markets. Aiming for the right market channel is part of upgrading the vertical relationships. An efficient marketing system when trading with agricultural products is of high importance since it contribute to decrease losses caused by inefficient processing, transportation and storage and therefore increase the marketable surplus (Khols & Uhl, 1998). This leads to better prices for the farmers' and a possibility to invest their surpluses in modern inputs. Where a firm is positioned in a market channel depends according to Stern et al. (1996) on several factors. The firm needs to consider which services or/and products they aim to deliver to which market. In order to do that the firm needs to know the required characteristics both for the product or service as well as for the production process. The length of the market channel also has impact, for example if it is desirable for the producer to deliver directly to end-customers or through intermediaries. Another aspect to consider is if the firm has possibilities to be part of more than one market channel depending on capabilities of the firm and different market requirements.

The form of retailing is changing in many developing countries and the modernization as well as globalization changes the market structures and channels (Humphrey, 2007). Requirements on food safety and quality increase and it can be difficult for small actors to meet these and to compete with larger actors such as supermarkets. Larger wholesaler markets that consistently can provide and deliver standard products at favorable prices can be part of these upgraded chains. This if the market is efficient and competitive and the actors are able to meet the new requirements. In order to do this, investments in market infrastructure need to take place to improve and maintain hygiene and storage conditions. Private and public regulations of food safety in the value chain also have an impact.

Upgrading of horizontal relationships can include different forms of joint collaboration such as; marketing, use of facilities, purchasing of inputs and product differentiation (Trienekens, 2011). Formation of cooperatives, producer associations or public- private relationships can be a way to upgrade horizontal relationships in value chains in developing countries (Narrod et al., 2009; Roy & Thorat, 2008; Saenz-Segura et al., 2007). An example from Costa Rica

shows that small-scale pepper producers that formed a collective marketing system increased their bargaining power against the monopoly of one processing firm (Saenz-Segura et al., 2007). In the same study Saenz-Segura et al. (2007) modeled favorable market conditions where it is profitable both for the firm and the farmers with joint collaboration amongst the farmers and the bargaining power of the farmers' increases. However, to accomplish this scenario the farmers need outside help to increase and stabilize their production. Horizontal collaboration in forms of marketing cooperatives can be a way to decrease losses in chains for horticultural products (Kader, 2004). The losses can be decreased as the cooperative act as a selling unit for members, provide accumulation points for the products and facilitate transportation and storage. Another advantage is if the cooperative can purchase and provide harvesting and packing supplies for their members.

3.3.2 Upgrading of value added production

Upgrading of value added can be executed in different ways where the most common are; upgrading products, upgrading of processes, functional upgrading and inter-sectoral upgrading (Trienekens, 2011). Functional upgrading refers to in-sourcing of production or distribution and inter-sectoral upgrading to diversifying the business. Upgrading of products and processes are the most frequently used value added upgrading option in developing countries. Upgrading of products can be both external and internal (Trienekens, 2011). External upgrading is more related to the characteristics of the process such as organic production or fair trade. Internal upgrading regards to attributes such as packaging, quality of the product, composition etc. Improvements regarding packaging, handling, transport and storage facilities are important factors in order to increase quality and minimize losses of fresh produce (Kader, 2004). Information and knowledge how to handle and maintain quality of horticultural products need to be improved in many developing countries. In order to improve safety and quality of production as well as production processes several standard quality assurance systems and certification systems can be implemented (Trienekens & Zuurbier, 2008). These standards are however mostly implemented in developed countries.

Process upgrading relates to the products, distribution and production optimization (Trienekens, 2011). In order to optimize the production new technologies that increase the level of automatization are often needed. Distribution can be upgraded by new transportation technology, cooling systems and better communication between the actors in a supply chain by introducing GPS systems, internet or mobile phones. Functional upgrading is low in developing countries as they often are suppliers for developed countries, and the value adding therefore occurs in the latter parts of the chain (Dolan and Humphrey, 2000). Some value added activities, such as juice processing, have increased in developing countries. But value adding in form of marketing and branding is still mainly performed in developed countries.

3.3.3 Upgrading of governance structure

The distribution of value added in the chain and which governance form that are used have a strong connection. Therefore upgrading of governance structure is of high importance in order to capture value added in the chain. Trienekens (2011, p.68) defines upgrading of the governance forms in value chain as "choosing the right organizational form with horizontal and vertical value chain partners." The choice of governance structure is affected by how dependent the actors in the value chain are on each other and the variances in market power (Trienekens, 2011). One actor with a lot of market power can determine the governance mechanisms (Ruben et al., 2007). Small-scale producers or actors are therefore in many cases dependent on downstream parties such as intermediaries (brokers, wholesalers), transporters and exporters in the value chain to get market access and inputs. It is desirable to increase

these actor's capabilities and processing possibilities to balance the bargaining and power relationships in value chains (Fitter & Kaplinsky, 2001). In more developed market-oriented value chains it is common with direct trading relationships between producer groups or larger producers and downstream parties and the importance of intermediaries decrease when value chains become shorter (e.g. Bair & Gereffi, 2003).

An improvement regarding the information exchange in value chains is the use of cell phones which have increased among producers in developing countries and enabled them access to better market information (Trienekens & Willems, 2007; Ruben et al., 2007). In south Africa Trienekens & Willems (2007) found that the quality of fresh produce were improved, as the increased use of cell phones improved transportation and logistics planning.

Horizontal collaboration is an important driver to increase the bargaining power of small-scale producers or actors and the information flow in the chain (Ruben et al., 2007; Trienekens, 2011). Horizontal relationships such as farmer's cooperatives or associations may also enable joint investments in areas of production, distribution and marketing and can be a way to get access to different markets. Furthermore retailers can lower their transaction costs by trading with cooperatives or associations instead of many small producers. Another way to reduce transaction costs and uncertainty within the chain is to write delivery contracts between the actors (Ruben et al., 2007).

4 Method

In this study the empirical data was collected through personal interviews with actors within the supply chain for avocado and mango in Ethiopia. Case study design is chosen as the method for the study and qualitative data was collected through personal interviews. The data was analyzed with help from literature regarding; the two products, supply chains in Ethiopia, post-harvest losses in developing countries and a theoretical framework regarding value chain analysis in developing countries.

4.1 Choice of approach and strategy

An explorative approach was chosen for this study, this in order to find information about the supply chains of mango and avocado in Ethiopia and causes of post-harvest losses. An exploratory approach is appropriate in a study when the aim is to cover a persistent or a new phenomenon as well as investigating an upcoming interest (Babbie, 2010). Post-harvest losses are a consistent problem for perishable goods, such as fruits (Kader, 2003). It is not a new phenomenon, but there is a lack of and a need for more research within this area since research in agriculture and horticulture mainly have been focused on how to increase the production. The horticulture production and marketing has a great potential to expand in Ethiopia (pers. com., Chaka, 1, 2014). However, there is a lack of research regarding post-harvest losses and market conditions in the supply chains of mango and avocado in Ethiopia. A descriptive approach would not cover all research questions and an explanatory approach is not suitable since little previous research is conducted in this particular area, therefore an explorative approach is well suited in this study.

After deciding which research approach is suitable, the research strategy for the study has to be selected. Quantitative and qualitative strategies are both widely used in research (Robson, 2011). The strategies differ in several ways regarding the researches role, the characteristics of the data collection and the intention of the study. In a qualitative study the enumerator seeks to identify specific characteristics and meaning of a phenomenon (Widerberg, 2002). When conducting a quantitative study the focus lies on the frequency and quantity of a phenomenon (Widerberg, 2002). In this study, case study design is chosen as the research design. Case study design is often considered as a qualitative strategy and qualitative data was collected in this case study (Robson, 2011; Bryman, 2004). A qualitative study is suitable in this study since the aim is to identify the characteristics for the supply chains design and its actors. Furthermore the aim is to investigate the phenomenon post-harvest losses in the chains and to identify were the losses occur. The quantity of losses on each actor level was also investigated but analyzed in a qualitative way in order to find out where the largest losses occur in the supply chains. In this study the qualitative data was also analyzed to see which activities and factors affecting the losses. Furthermore the possibilities for upgrading and improvements within the supply chains were answered with the empirical information.

4.1.1. Case study design

The chosen research design in this study is a case study of the supply chains for mango and avocado. Case study design is suitable for this study because it gives a holistic view of the supply chains and its actors and connections. Furthermore case study design is suitable for a study with an explorative approach since it provides insight and depth into a new or upcoming phenomenon (Ellram, 1996). Typical features of the design are that a single case or a small number of cases of an individual, situation, group of concern or interest are selected and

studied in its context. Case study is a suitable research design for studies of supply chains since a case study allows the researcher to directly observe the field which is convenient to cover the different stages of the supply chain (Seuring, 2008). In this study each supply chain for mango and avocado was considered as a case and consists of the actors within the chains.

Critiques and concern regarding case study design are several, for example Yin (2009) addresses problems with lack of rigor when undertaken a case study. Therefore it is of high importance that the researcher report and document all information fairly. Another concern is the lack of generalizations in case studies. Ellram (1996) means that the best way to increase the possibility of generalizations is to replicate case studies to verify patterns. Yin (2009) points out that a case study is not generalizable to populations or universes but to theoretical propositions.

4.2 Choice of theoretical framework and literature review

Prior to the empirical data collection the literature review and the theoretical framework were written. The search for articles and relevant research was gathered from databases such as PRIMO and Google Scholar. Key words used separately and combined when searching the databases were; post-harvest losses, post-harvest management, Supply chain management, value chain, supply chain of fruits in Ethiopia, avocado production, mango production. To find literature, which can be adapted in these setting for post-harvest losses and management in Ethiopia has been a challenge.

The literature review in this thesis is conducted in order to create an understanding for avocado and mango production. Furthermore knowledge regarding causes of post-harvest losses and the most appropriate post-harvest handling of the fruits were obtained from the literature review. The literature review was then used as a background for the interview questions as well as a tool when analyzing and discussing the empirical information. The theoretical framework chosen in this study is based on Trienekens (2011) value chain analysis for developing countries. The framework consist of three parts were value chain constraints is the first part and is used to identity what constraints exists in the chains regarding market access, institutional voids, resources and infrastructure. The second part is the value chain analysis where the network and governance structures in the chains are investigated and the value added activities are identified and were the value added is distributed among the actors. The last part regards possibilities for upgrading and improvement within the value chains.

The framework is used to analyze the supply chains for mango and avocado in Ethiopia with basis that the chains are situated in a developing country. Theories regarding supply and value chains more directed towards developed countries can be difficult to adapt in this context as such attributes as technology and access to capital can differ to a great extent. Trienekens (2011) framework includes global value chains, these has been excluded in this study as it only targets the national market in Ethiopia. Instead other research papers, not contained in Trienekens (2011) framework, have been added in the theoretical framework in this thesis in order to elaborate and include other parts. Kader (2004; 2009) research papers regarding post-harvest losses of fresh produce and post-harvest technologies for developing countries are added to cover the post-harvest losses perspective.

4.3 Choice of data collection method

There four main methods for collecting data information; interviewing, observing, survey or survey or testing (Robson, 2011). In this study interviewing is chosen as the method for the data collection. The interviewing strategy is based on a daily life conversation but applied in a professional research setting in order to search for information (Kvale & Brinkmann, 2009). The aim for the interviewer during a research interview is to control and define the conversation. Interviews can be an adaptable and flexible way to get useful information in a research study (Robson, 2011). There are disadvantages with choosing interviews as a strategy as they are time consuming and require resources. Issues regarding reliability and bias are also factors that need to be considered when undertaken interviews.

Interviews can be conducted personally, via telephone, mail or e-mail (Robson, 2011). The different choices have both advantages and disadvantages. In this study personal interviews are chosen because it gives the researcher a possibility to follow up responses, explain the interview questions and investigate underlying motives (Robson, 2011). It also gives the respondent an opportunity to ask the researcher questions if something is unclear. Obstacles in undertaken interviews for this study lies in the author's language barrier. To overcome the language barrier a translator helped during the interview sessions. To perform interviews via telephone, mail or email would have been difficult since a large percent of the population in Ethiopia do not have access to telephone or internet (www, Unicef, 2014).

How interviews are performed differ, based on how the interview is structured and the questions level of standardization. Robson (2011) distinguish between three main categories; fully structured interview, semi-structured interview and unstructured interview. When conducting a semi-structured interview, the researcher/interviewer follows an interview guide to cover the topics. The questions are "written" in a default order and wording. Depending on the flow of the interview, the researcher can modify the order and wording of the questions and add unplanned questions to follow-up interesting matters that have risen during the interview. The aim for this study is to explore a phenomenon, post-harvest losses, and therefore semi-structured interviews is chosen in order to have the ability to modify the questions and the order, but still have some structure during the interview sessions.

4.4 Research design

4.4.1 Study area

Ethiopia is a landlocked country and stretches 1 133 380 km^2 over Africa's horn (www, landguiden, 2014). The country borders to Kenya, Somalia, Sudan, South Sudan, Djibouti and Eritrea. It has over 94 million inhabitants and 82.49 percentages of the population lives in rural areas (www, faostat, 1, 2014). The landscape in Ethiopia is diverse and therefore the climate varies to a great extent (www, FAO, 1, 2014). It is possible to grow a wide range of different crops and the agriculture sector with a large number of small-scale farmers is important for the country. It represents 50 % of the GDP and the most significant crops are different types of cereals, roots and tubers, coffee and beans (www, faostat, 1, 2014). The production is vulnerable and the country has suffered from severe draught and floods during the latest years (www, FAO, 1, 2014). The fruit production in Ethiopia has been small compared to other crops but it has great potential since the climate is favorable for many horticulture products (Berhel et al., 2010).

In Figure 3 a map of Ethiopia with the three different locations for the data collection is shown. The first location is the areas Yirga Alem and Wondo Genet where the interviews with avocado producers and brokers were conducted. The second location is the area Baco where the interviews with mango producers and brokers were conducted. The third location is the capital Addis Ababa where the interviews with wholesalers, retailers and restaurants where conducted.

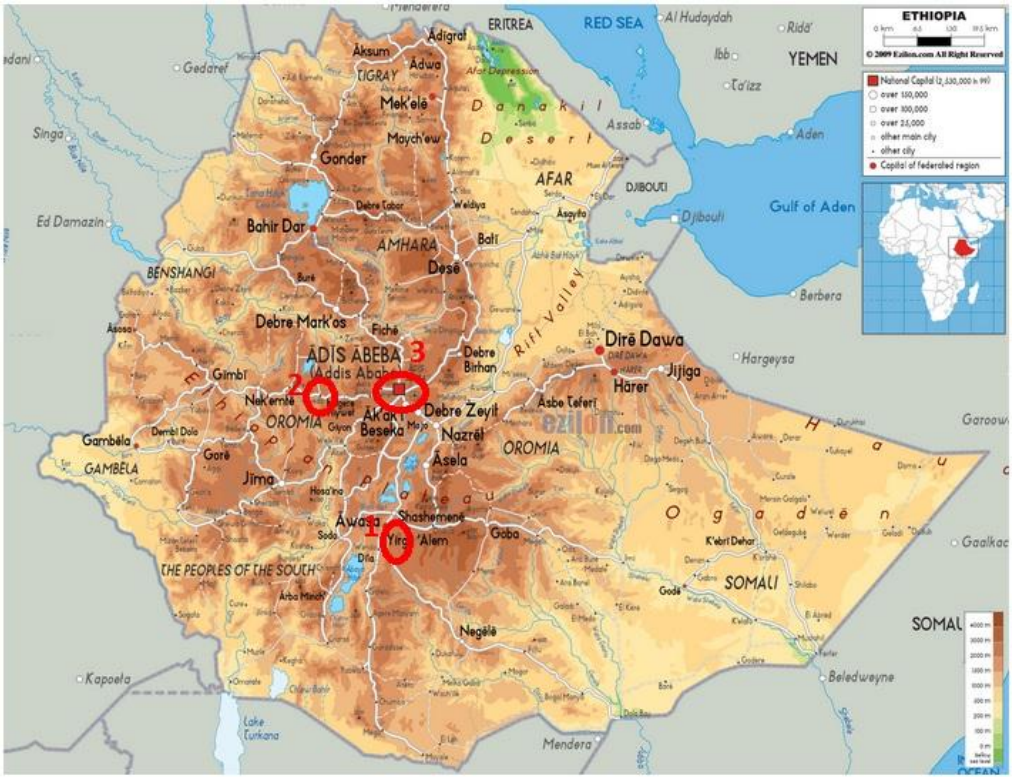

Figure 3. Altered by the authors, map of Ethiopia and the study areas (www. Ezilon, 2014).

4.4.2 Collection of empirical data

To define the actual case for a study the units of analysis have to be chosen (Yin, 2009). The unit of analysis has to be connected to the research questions and the theoretical framework. The unit of analysis in this study is the supply chains for mango and avocado and the selection of the respondents is based on their role in the supply chain. To be able to select and target appropriate respondents the authors needed expert judgment from offices for agricultural and rural development and from universities in each study area. To overcome the language barrier students from Addis Ababa University, Ambo University and Hawassa University helped with translation during the interviews. Interviews were carried out with five different groups of actors in the supply chains for mango and avocado; farmers, brokers, wholesalers, retailers and restaurants. The groups were selected from the knowledge obtained from the literature review. In each supply chain ten farmers, five brokers, five wholesalers, five retailers and five restaurants were interviewed. The number of respondents in each group is based on their relative amount in the chain. As the farmers are more in number than the brokers and wholesalers the number of respondents is greater. Both retailers and restaurants have the same position in the chain, and therefore the number of respondents in these groups is smaller. The interviews were conducted from 11th of April to 7th of July 2014.

4.4.3 Quality of data collection

In all science it is important to ensure high quality of the data collection (Robson, 2011). In quantitative studies there are standardized instruments to ensure reliability and validity. In qualitative studies there are no such standardized tests and it can therefore be a challenge for the researcher to ensure the quality of the study. Reliability reflects the repeatability of the study and if a replication would be possible with the same results (Ellram, 1996). To ensure the reliability the researcher should use a case study protocol and develop a case study data base. In this study the case study protocol consists of the interview guide and the procedure for how the interviews were carried out. A case study data base were also used, where all empirical information were written down. To construct validity means to identify correct measurements for the studied concept (Yin, 2009). In this study the concept and measurements from the theoretical framework and literature review was used, such as; the network structure, post-harvest losses, the information flow and transaction characterizes.

As interviewing is the method for data collection in this study it is significant that they are of high quality. Both the interviewer and the respondent are involved to ensure interview quality; however it is the interviewer's skills in conducting interviews that determines the quality (Kvale & Brinkmann, 2009). It is of high importance that the interviewer has the ability to interact and connect with the respondent in order to steer and modify the interview depending on the conversation flow. Other factors affecting the quality of the interview and data collection are the interviewer's knowledge about the topic and ability of data interpretation (Kvale & Brinkmann, 2009). To improve the quality of the interviews in this study, a pilot interview was carried out before conducting the actual interviews. Knowledge about post-harvest losses and the supply chain actors as well as production and post-harvest management of avocado and mango were obtained through lectures and literature as well as Internet searches. Issues related to bias can occur when undertaking research involving people and the researcher should be aware of the problem and put emphasis in avoiding it (Robson, 2011). In a qualitative study there are no standardized instruments and therefore it is of high importance that the research is carried out in a careful, honest and thorough way.

4.4.4 Ethical aspects

Interviewing can be a useful instrument to gather data for a study. However, there are ethical aspects that need to be considered when involving people in real world research (Robson, 2011). The interviewer aims to gather high level information from the respondent, but have to be aware of and respect the respondent's personal integrity, which can create a dilemma for the interviewer (Brinkmann & Kvale, 2005). It is of high importance that the researcher is aware of the power relationship between the actors in a research interview compared to a normal conversation. The power relation in an interview is asymmetrical and the researcher set the agenda and defines the situation. A research interview is a one-way dialogue and may be even manipulative in some features. Therefore the interviewer should put emphasis on informing the respondent about the characteristics of the research project and the respondent's right to withdraw from the interview at any time. Furthermore it is important that the respondent will be anonymous and their answers will be confidential and only used within the research project (Robson, 2011). This increases the respondent's willingness to give reliable answers. In this study the respondents were approached and asked if they would like to participate in an interview. During the same time they were informed about the purpose of the study and the background of the authors. During this introductory phase the respondents were also informed about the confidentially of the study and their possibility to withdraw from the interview as well as the fact that there are no right or wrong answer.

4.5 Interview guide

The interview questions are derived from the literature review and theoretical framework and can be seen in Appendix 1, 2 and 3. The aim of the interviews was to collect information about the different actors within the supply chains for avocado and mango and if it occurs post-harvest losses. Furthermore, the aim was to evaluate the value chain for the two fruits and to quantify the losses. The interview questions for all groups were focused on post-harvest activities of the fruits such as handling, treatment, transport and storage. Questions were also asked regarding if post- harvest losses occur during the different activities and if so the causes and quantity of the losses. Furthermore questions regarding the market such as price, information and market power were discusses with the respondents/ interviewees. At the end of the interviews the respondents were asked about their opinion regarding problems in the supply chain and suggestions on how to improve them. The groups who harvest the fruits; farmers,brokers and wholesalers were asked questions regarding their harvest practices.

4.5.1 Farmers

The production of the fruits is the first stage in the supply chain and the farmers are therefore the first group targeted. Interviews with 10 famers in the avocado supply chain were conducted in Wondo Genet and Yirga Alem. In the mango supply chain 10 interviews with farmers were conducted in the area around Baco. The choice of area for the interviews of avocado and mango farmers was based on information from the Agriculture College at Ambo University in Ethiopia. The authors asked for areas where the two fruits are important crops. Furthermore areas where universities and offices of agricultural and rural development were able to offer support were preferred by the authors.

According to Chaka (pers. com., 1, 2014) at Ambo University the areas surrounding the city Hawassa is well known for its avocado production and an important area for the supply of avocado to the central market in Addis Ababa. In Hawassa the agriculture ministry was contacted and the specific areas of Yirga Alem and Wondo Genet were suggested as suitable areas for conducting the interviews. In both Yirga Alem and Wondo Genet the offices for agriculture and rural development was contacted and both pointed out that avocado is an important crop in the areas. Furthermore the offices were contacted with the purpose of receiving help to locate the farmers and assistance to approach the farmers and to increase their understanding of the purpose of the interview. The first interviews at both locations were performed at the respondents' farm, this in order to increase the understanding of the production and location. To make the procedure more efficient and less time consuming the rest of the interviews with the farmers were conducted at the offices for agricultural and rural development. Chaka (pers. com., 2, 2014) at Ambo University also stated that Baco is an important area for mango production. The office for agricultural and rural development in Baco was contacted to receive the same help as in Yirga Alem and Wondo Genet. The procedure of the interviews with mango farmers were the same as for the interviews with avocado farmers.

4.5.2 Brokers

The broker is the next actor in the supply chains. Interviews with five brokers involved in the avocado supply chain were conducted in Wondo Genet and Yirga Alem and five interviews with brokers involved in the mango supply chain were conducted in the area around Baco. The procedure of choosing the area and finding the brokers were the same as for the farmers.

4.5.3 Wholesalers

Interviews with 10 wholesalers, five in each supply chain, were conducted at the fruit market at Piazza in Addis Ababa. The location of the respondents is based on the knowledge that fruit from Baco and Hawassa areas are sold at Piazza. Furthermore the fruit market at Piazza is one of the largest in Ethiopia (Shumeta, 2010). The selection of the specific respondents was performed by walking around in the different parts of the market and asking wholesalers if they trade with avocado or mango and if they were willing to be part of the study. As there is a language barrier for the authors; the translator was the one approaching the wholesalers.

4.5.4 Retailers

The retailers were the next group interviewed in this study and five retailers from each supply chain were interviewed. The chosen respondents were located at different locations in Addis Ababa. Addis Ababa is chosen as the location as the fruit sold from the previous group in the supply chain, wholesalers at Piazza, are bought from retailers in Addis Ababa. The respondents are chosen by their willingness to answer the questions and by their location, with the goal to spread out the locations of the retailers. Furthermore the size of the retailers business has affected the choice, this to attain a spread in business size. The group of retailers exist of both fruit stalls and supermarkets.

4.5.5 Restaurants

The restaurants have the same position as the retailers as they mostly sell their products directly to the consumer. Five restaurants in each supply chain are interviewed in Addis Ababa. The respondents are chosen on the same basis as the retailers.

4.6 Data analysis

Depending on the characteristics of the data collection there are different methods to analyze and interpret the information found (Robson, 2011). Analyzing data refers to categorize, tabulate, test or in other ways recombine evidence in order to make conclusions based on the empirical data (Yin, 2009). When undertaking an analysis of the case study it is desirable to follow an analytic strategy. The strategy in this study is to rely on the theoretical proposition and the literature review in order to analyze the collected empirical findings. In this study the qualitative data was structured and summarized under different categories based on the theoretical framework. Further on the qualitative data was analyzed using thematic coding analysis with the literature review and theoretical framework served as a basis. Thematic coding is a generic approach and can be used with different theoretical frameworks or with a purely exploratory or descriptive basis (Robson, 2011). The first step when carrying out a thematic coding analysis is to transcribe and read the data. Next phase for the researcher is to generate initial codes and identifying themes followed by constructing thematic networks and make comparisons leading to the last step where the researcher integrate and interpret the data. The aim was not to analyze each individual actor but to retain a holistic view of each level and the supply chains as a whole.

5. Results

In this chapter the results from the interviews are presented. The interview questions can be seen in Appendix 1, 2 and 3. First the supply chain of avocado and its actors is described and thereafter the mango supply chain is described. The last section presents the prices and price information in both supply chains. The actors found in the study were farmers, brokers, wholesalers, retailers, restaurants and consumers. The actors and how they trade with avocado and mango in the chains are shown in Figure 4.

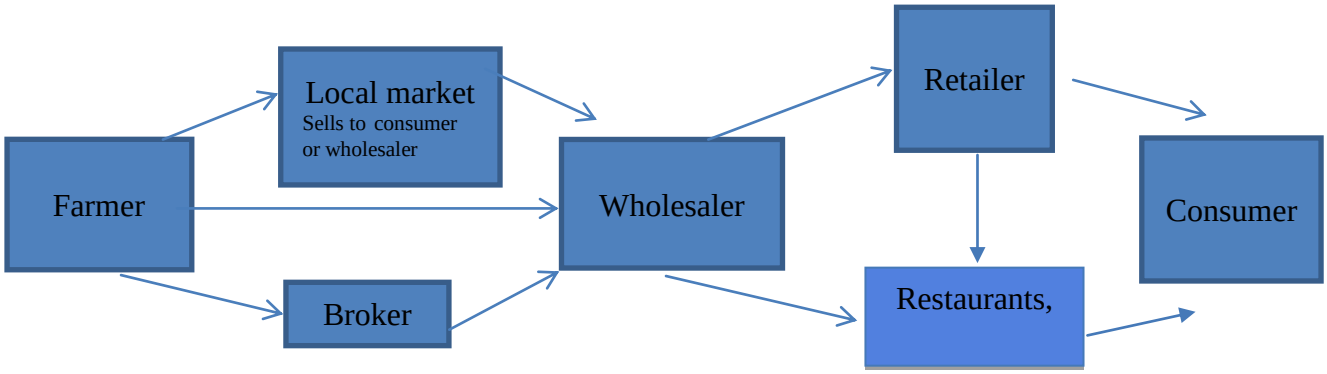

Figure 4. Actors in the supply chains for mango and avocado and how the fruit is traded between the actors.

5.1 Supply chain of Avocado

5.1.1Farmers

The farmer is the first actor in the supply chain for avocado. The farmers interviewed are located in Yirga Alem and Wondo Genet areas in south Ethiopia. In Figures A1 and A2 in Appendix 4 the amount of trees per farmer and yield in kg per tree and year is shown. All interviewed avocado farmers have what they call a local variety of trees. Three of the farmers also have what they referred to as an improved variety if trees. All the local varieties are seeded and the improved varieties are grafted. Half of the ten farmers interviewed in this study are using irrigation for the avocado trees. Three of them only use irrigation during dry season, one of them only for the juvenile trees and another only uses irrigation for the grafted trees. Eight of the ten interviewed farmers recognize that they have problems with diseases on the avocado trees. The symptoms mentioned by the farmers are that flowers and immature fruit fall from the tree. One of the farmers that have both improved and local varieties of trees do not have any disease problems with the improved varieties. None of the farmers treat the diseases in any way.

All of the ten interviewed farmers harvest the avocado manually by pulling the fruits from the trees using a long stick with a hook attached on the end. Two of the three farmers that have improved varieties of trees harvest the fruit by hand as the trees are smaller and therefore easy to climb. Seven of the ten interviewed farmers state that the fruit falls to the ground during harvest, but five of them have someone that tries to catch the fruit. Two other farmers put leaves on the ground to smoothen the fall of the fruits. Two farmers have a small bag on the harvest stick where the fruit falls in to, instead of hitting the ground. For all of the farmers interviewed in this study the color change of the fruit is the main method to distinguish if the fruits are mature enough to harvest, as the fruits become darker when they mature. Two of the farmers use size of the fruit together with change in color to make the decision when to

harvest. None of the farmers harvest all the fruit at the same time, only the fruit that is mature is harvested. One of the farmers states that it is the market demand that decides the amount of avocado to harvest, this to make sure that the entire amount of harvested fruit can be sold. All of the interviewed farmers harvest their avocado in the morning, where two of them specify that they wait until the ground is dry. None of the farmers treat the fruits in any way after harvest, but two farmers wash the fruits. None of the farmers keep the fruit on the field for longer than 2 hours, and all of them keep the fruit in the shade during this time. Half of the farmers have the fruit loose on the ground on the field, where the rest keep them in baskets, boxes or kuntals. Kuntals is jute sacks that hold approximately 75 kg of fruit.

As shown in Figure A6 in Appendix 4 the greatest losses of avocado for the farmers occur during harvest and all farmers except one have losses during this activity. All of the farmers say that the main problem is that the fruit may crack when it falls to the ground from the tree. One farmer also states that some losses are caused by that the fruit over matures on the tree, and another farmer says that some immature fruit falls down during the harvest. Four of the ten farmers store the avocados at their homestead before they transport the fruit to the market. Three of them store the fruit in jute sacks and one of them has the fruit loose on the floor.

None of the interviewed farmers cool the fruit. Seven of the ten farmers sort the fruit after harvest, were five of them sort after size and the other two sort according to how ripened the fruits are. As shown in Figure A6 in Appendix 4 the second largest losses in average for the farmers occur during storage. Three of the four farmers that store fruit have losses of avocado during storage, they mention two reasons for this; the fruit is not mature enough when it is harvested or the fruit over ripens. All of the farmers think that the quality of avocado differs between their trees, where eight of them specify that it is the size of the fruit that varies. The three farmers that have improved varieties state that these trees have larger fruits.

All of the farmers transport the avocado, where half of them transport by donkey backs and the other half by donkey carts. Half of the farmers only transport the fruit in jute sacks, and the rest in both jute sacks and baskets that can be filled with 25 kg of avocado. As shown in Figure A6 in Appendix 4 transport is the activity where the farmers have the smallest amount of losses. Four of the ten farmers state that they have losses of avocado during transport due to; over ripen fruit, fruit falls of the transport means and thieves steal fruit during transport.

All of the ten interviewed farmers sell their avocado at local markets within an area of 10 km from their farm. Six of them also sell avocado at their farm gate. . All of the farmers sell avocado to wholesalers and one farmer also sells to brokers. Four of the farmers in the Yirga Alem area are members of a farmers' association which they sell avocado to. The farmers' association buy avocado from their members two times per week. The association facilitates for storage and also provides their members with harvesting tools and plastic boxes. The association transports the avocado and sells it at the central market in Addis Ababa The farmers that are members of the farmer association has stopped selling to brokers after becoming a member, but has kept wholesalers as customers.

Half of the ten interviewed farmers think that wholesalers have the most influence in the supply chain for avocado while two farmers believe that it is the brokers that have the most influence. Two farmers say that it is both of them. The tenth farmer believes that both the producers and wholesaler have the most influence in the chain. Seven of the farmers think that wholesalers and brokers are part of the greatest problems in the supply chain. Two of them specify that they do not come at the right time, and four of farmers say that they control the prices. Price fluctuations, lack of transport and storage are also problems in the supply chain mentioned by the farmers. The farmers suggest more organized markets and formation of

farmers' cooperatives and associations in order to improve the supply chain. One farmer believes the government should contribute to make the improvements. More markets to sell avocado to are also desired by several farmers.

5.1.2 Brokers

The brokers are the second actor in the supply chain for avocado. The five brokers interviewed are located in Yirga Alem and Wondo Genet areas in south Ethiopia. Three of the five brokers, which are all interviewed in the same area, act as the link between farmers from the local area and wholesalers from Addis Ababa. Their role is to help with agreements and exchange of information between the actors. The two other brokers from another area buy avocado from farmers and sell to wholesalers at local markets within an area of 10 km. One of them stores the avocado over the day at the market outside. The other broker sometimes store avocado at the homestead when there is avocado left. These two brokers always transport the fruit and use donkey carts or human back. The avocado is transported in jute sacks or baskets. None of the brokers cool the avocado. Both brokers trading with avocado sort the avocado by size. Out of the five interviewed brokers it is only two that have any losses, this as the other three never handle the fruit. The losses occur at the market in conjunction with selling and these are according to the brokers so small that they cannot be estimated.

The brokers think that the greatest problems in the supply chain are; shortage of wholesalers and markets, supply and demand not matching and that parties change prices after agreements are made. To improve the problems in the chain the brokers desire more markets to trade at and wish that more wholesalers would come to their area to buy mango. One suggestion is to improve the roads so the wholesalers have better access to the area. Better information flow between the actors and more organized market places with quality controls is also suggested as solutions to the problems in the chain. Three brokers think that the wholesalers have the most power in the chain and the two other brokers believe that the producers have the most power.

5.1.3 Wholesalers

Wholesalers are the third actor in the supply chain and all wholesalers are interviewed at Piazza, the central fruit market in Addis Ababa. Four of the five interviewed wholesalers buy avocado from brokers and the fifth buy avocado directly from farmers. One of these wholesalers has one regular broker in each region. The avocados are bought from south and southwest Ethiopia at distances from 300 km up to 450 km from Addis Ababa. The wholesalers buy avocado from three times per week up to every day and the amount differs from 1500 kg per time to 3750 per time. The wholesalers sell avocado to juice bars, retailers, hotels, supermarkets, restaurants and wholesalers, all located in Addis Ababa.

Three wholesaler transport the avocado themselves and the two other wholesalers have brokers that transport for them. All of the wholesalers use Izuzu trucks as transport means which holds approximately 3750 kg of fruit. The wholesalers transport the fruit loose on the truck or in jute sacks. As shown in Figure A7 in Appendix 4 the wholesalers have losses during transport. Two of the five avocado wholesalers state that they have the largest losses during transport. They all say that the main losses are in conjunction with loading and unloading, where one of wholesalers blames the largest losses on thieves during unloading. One of them also has problems with avocados falling off during transport as the avocados are loose in the truck. The two other wholesalers state that the largest losses occur during storage Three of the wholesalers have a selling location at Piazza where they sell avocado. The facilities used are; stall under roof, warehouse with one open wall or a location with no roof.

One wholesaler keep the fruit loose at the selling location, another keep the fruit in wooden boxes and the third uses both. Three wholesalers keep the fruit in a storage facility before selling the fruit at the market. Two of them store the avocado in jute sacks and one wholesaler uses wooden boxes. One wholesaler sells avocado directly from the truck and therefore has neither a selling location nor a storage facility. None of the wholesalers cool the avocado. As shown in Figure A7 in Appendix 4 losses in average are largest during storage and at the selling location for the wholesalers. Three of the five interviewed wholesalers state that they have the largest losses during these activities. The main reason for the losses are due to that the fruit over ripens. The quality of avocado is measured by the wholesalers visually and by size. Production area and variety also have impact on the quality. The avocado is sorted by quality and ripening stage both by the seller and by the wholesalers. There are no quality standards in Ethiopia for avocado according to the wholesalers.

Three of the wholesalers believes that the brokers have the most power and influence in their supply chain. One wholesaler thinks that themselves, wholesalers at Piazza, has the most influence and another wholesaler state that the farmers have the most power in the chain. There are no organizations or associations for wholesalers trading with avocado according to the wholesalers. The greatest problems in the supply chain according to the wholesalers are; poor harvesting techniques, supply problems during rainy season, farmers controlling the prices, price and supply fluctuations. Expensive and poor storage, the brokers' power in the chain and the management at Piazza are also mentioned as great problems. To improve the problems and minimize the losses of avocado in the chain the wholesalers suggest; improvement of farming and harvest practices, covered market places and better storage. Another wholesaler thinks that standards for the whole chain should be implemented and that the government should improve the conditions at Piazza. Better transport with improved packaging and cooling system are also mentioned as ways to minimize the losses of avocado. One wholesaler mentions implementation of digital market information and education of the actors in order to improve the supply chain.

5.1.4 Retailers

The retailers are one of the last actors before the end-consumer in the supply chain and all retailers interviewed are located in the Addis Ababa area. Two of the five interviewed retailers buy avocado from south Ethiopia via brokers. One retailer foremost get avocado delivered from the store's own farm located 40 km outside Addis Ababa, but also from other farms in the same area. The two other retailers buy avocado from wholesalers at Piazza, but one of them also buys from brokers that come to the store. The retailers buy avocado two times per week or three times per week and the amount differs from 70 kg to 400 kg per time. All of the retailers sell avocado to home consumers and three retailers also sell to restaurants. Two retailers have hotels as customers and one retailer also sells to juice- cafés. One retailer makes and sells avocado juice additional to the selling of unprocessed avocado.

Three of the retailers display the avocado loose outside under roof. The fourth retailer displays the ripe avocado loose outside under roof and keeps the unripe fruit in boxes in the back of the store. The fifth retailer also displays the avocado loose but inside the store. Two retailers have storage facilities at their selling location and the avocado is stored in plastic or wooden boxes. The retailers that buy avocado from brokers say that the brokers facilitate the transport for them. The retailer that has its own production also has its own trucks and the fruit is package in plastic boxes. When buying avocado at Piazza the retailers organize transport themselves. The transport means used are pickup trucks or Izuzu trucks. The mango is transported in jute sacks, wooden boxes or plastic bags. As shown in Figure A8 in Appendix 4 the average losses are almost at the same level during transport as at the selling

location/storage facility. The losses during transport are mainly due compression damages and damages at loading and unloading. The losses at the selling location and storage facility are due to over ripen fruit and old mechanical damages.

Two of the retailers say that they do not affect the ripening process of the avocado. One retailer keeps the fruit in plastic boxes that is ventilated and in order to extend the shelf-life of the fruit. Two retailers cover avocado with plastic or newspaper to speed up the ripening process. One retailer washes the avocado and another retailer cleans the fruit with a rag. None of the retailers cool the avocado. All retailers say that the avocado is sorted by the seller before buying. Two retailers also sort the avocado themselves before they buy avocado at Piazza. The retailers measure the quality visually by the size and color of the avocado. All retailers sort avocado in ripening stage and take away bad fruit during storage.

There are no associations or organizations for the avocado retailers. Three retailers think the broker has the most power in the chain and another retailer thinks it is the wholesalers at Piazza. The fifth retailer does not know. The greatest problem in the supply chain for avocado is poor harvest and post-harvest handling according to two retailers. One retailer thinks that the lack of transport and that brokers do not come when agreed are the greatest problems. One retailer says that the "middle men" in the chain is a problem because they take all the profit. To improve the problems in the chain and to minimize the losses of avocado the retailers suggest better harvest and handling as well as improved transport and packaging. Implementation of cold chain is also suggested as an improvement by the retailers. The actors in the chain need more knowledge about the problems and how to improve them, says one retailer. One retailer wants to buy avocado directly from farmers or farmers' association instead of intermediaries.

5.1.5 Restaurants

The restaurants are one of the last actors before the end-consumer in the supply chain and all restaurants interviewed are located in the Addis Ababa area. Two of the five restaurants buy avocado from retailers near their own location, where one of them usually buys from the same seller every time. Two restaurants buy avocado at Piazza from one or two different wholesalers, but one of them also buys from supermarkets sometimes. The last restaurant buys avocado from one broker in South Ethiopia, 260 kilometers from Addis Ababa. Two restaurants buy avocado every day, where one buys 30 kg- 50 kg and the other 5 kg each time. The other three restaurants buy two up to three times per week and the amount of avocado differs from 10 kg up to 15 kg each time. One of these restaurants was not willing to share information about the amount avocado bought. All restaurants sell avocado as juice and two restaurants also sell avocado in fruit salads.

Two restaurants always transport the avocado and another restaurant transport sometimes. The transport means used are minivan, minibus or by walking and the avocado are packaged in plastic bags. None of the restaurants have any losses during transport. All restaurants store their avocado. The first restaurant keeps the avocado in the kitchen for 2-4 days. The ripe avocado is kept in plastic buckets and the unripe fruit in covered plastic boxes to ripen. The second restaurant keeps the avocado in the kitchen in plastic bags for 1 day and keeps avocado juice in the fridge. The third restaurant keeps the avocado loose in a storage at the restaurant for 1-7 days. The fourth restaurant also keep the avocado loose in a storage but for 3-4 days. The fifth restaurant store the avocado loose in a fridge with a temperature of + 8-+10 ^{o}C for one day. Three of the five restaurants interviewed about avocado have losses. The losses are very small and occur during storage due to over ripening.

The quality of avocado is measured visually and by touching the fruits. Four restaurants say that the avocado is sorted by the seller before buying and three restaurants also sort themselves before purchasing. One restaurant thinks that the greatest problem in the supply chain for avocado is poor knowledge and information especially between the farmers and brokers. The brokers do not give the right information to the farmers. Another restaurant mentions the price fluctuations at farmer and broker level as a great problem. Poor transport is also mentioned as a problem in the supply chain. In order to improve the problems improved transport are suggested by the restaurants. To minimize the losses in the chain the restaurants suggest better handling of avocado, covered transport and implementation of cold chain. One restaurant thinks the actors especially the farmers, who have a large amount of losses, need more knowledge. Four restaurants believe that the brokers have the most power in the supply chain and the fifth restaurant does not know.

5.2 Supply chain of Mango

5.2.1 Farmers

The farmer is the first actor in the mango supply chain. The ten interviewed farmers are located in Baco area in west of Ethiopia. The number of trees that each farmer owns can be seen in Figure A3 in Appendix 4. Eight of the ten interviewed farmers lease out their mango trees for the whole season to brokers or wholesalers that both harvest and sell mango. Two of the farmers harvest all their mango trees themselves. Most of the farmers keep a few trees for themselves to harvest, which they mainly use for home consumption. The farmers interviewed in this study do not know which varieties of mango trees they have, only that there is a difference in taste, size and appearance of the fruit. All of the interviewed farmers have seeded trees. Three of the farmers only use irrigation for the juvenile trees, while the rest of the farmers always use irrigation for the trees. All of the ten farmers have problems with a pest that has been a great problem during the last years. The farmers do not know what kind of pest it is, but think that it can be a fruit fly. None of the farmers treats the trees against the pest and seven of them state that there are no treatments available.

Both of the farmers that harvest themselves conduct this manually, by hand and by using a long stick with a hook attached on the end. The interviewed farmers decide when to harvest by looking at the fruits color and size and only harvest the mature fruit from each tree. Both farmers harvest in the morning. None of the farmers have harvesting tools that prevents the mango from falling to the ground, but both have someone that tries to catch the fruit instead. Neither of the farmers leaves the stem on the fruit, but instead they dry the fruit in the sun for up to one hour directly after harvest to prevent sap burn. In Figure A9 in Appendix 4 the average losses of mango for both farmers and brokers are shown. The largest amount of losses for the two farmers are during harvest due to; the fruit cracks when it falls to the ground, immature fruit is collected and that animals steel fruit from the tree.

Both farmers that harvest themselves also store the fruit before they sell them. Both of them store the fruit at their homestead, but one of them only stores them there during rainy season and under the trees on the field during the dry period. Both farmers store the mango for maximum one week and the fruit is packaged in jute sacks. They both have losses during storage due to over ripening, physical damage from harvest and mice that eat the fruit. Both farmers transport the fruit. One farmer only transports from the field to the house by human labor. The other farmer uses animal cart as transport mean and both of them transports in jute sacks. One of the farmers has losses during transport due to physical damage on the fruit that is ripened.

Seven of the farmers that lease out their trees have wholesalers as customers, and one lease out to both wholesalers and brokers. Three of them always lease out to the same wholesaler. One farmer uses brokers for the agreement procedure with the wholesaler. One farmer also sells some mango to home consumers at farm gate. One of the farmers who harvests sells the mango to a wholesaler and the other farmer sells to home consumers and retailers at two local markets four times per week. All farmers state that there are no farmer cooperatives in their area. Five of the farmers thinks that the quality of fruit from different mango trees varies. Two of the farmers thinks that the quality of the fruit is better when the trees are planted further apart. One of the farmers thinks it differs between years and another believes that the fruit quality increases with irrigation and manure. Another farmer thinks it depends on the variety, and that the trees received from the agriculture office gives fruit with better quality.

Half of the mango producers say that the main problem in the supply chain is a lack of markets and market access. The farmers also mention; poor packaging, overloaded transports, low prices for the producers and a wholesale monopoly as problems in the chain. The new pest is stated as a problem and access to pesticides are desired by the farmers. The farmers believe that prices and market access can be improved with farmer cooperatives and government interference. One farmer thinks that the market access can be improved by eliminating the brokers which results in direct contact between farmers and wholesalers, while another believes a processing industry is the solution for the lack of markets. Other suggestions for improvement are; new varieties of mango, improved harvesting techniques, improved transport and packaging. Half of the farmers think that brokers have the most influence in the chain. Four farmers say that it is the wholesalers, and one farmer believes both brokers and wholesalers have the most influence.

5.2.2 Brokers

The second actor in the mango supply chain is the broker. The five interviewed brokers are located in Baco region in west of Ethiopia. All of the five interviewed brokers lease mango trees from farmers during the mango season. One broker also negotiates between farmers and wholesalers and works as a harvester for other brokers. The brokers lease mango trees within an area of maximum 60 km from their hometown Baco. The average number of trees leased per year can be seen in Figure A5 in Appendix 4 and the average mango yield harvested by the brokers can be seen in Figure A4 in Appendix 4.

The brokers harvest manually, both by hand and by using a long stick with a hook attached on the end. The brokers decide when to harvest by looking at the fruits color and size and harvest only the mature fruits from each tree. One of the brokers says that the demand on the market impacts when to harvest, if the prices are low they try to keep the fruits as long as possible on the trees and wait for better prices. All brokers harvest in the morning. None of the brokers have harvesting tools that prevents the mango from falling to the ground, but they all have someone that tries to catch the fruit instead. None of the brokers leave the stem on the fruit, but instead they dry the fruit in the sun for up to one hour directly after harvest to prevent sap burn. Four of the five brokers in the mango supply chain say that the losses are largest during harvest, which is also shown Figure A9 in Appendix 4. The losses are mainly due to physical damages when the fruits fall to the ground from the tree and that unripe fruit is collected.

All the brokers store their mango at the farmers' homestead where they rent trees, if there is shortage they also rent storage from farmers neighbours. One broker stores fruit in Addis Ababa when he sells fruit there. Another broker rent an additional storage at a local market. The storage facilities at the farmers' homestead have roof but no walls. The mango is packed in jute sacks and is stored between 4 days and 10 days, depending on ripening stage and

weather. The losses that occur during storage are mostly due to mechanical damage or sap burn that can be derived back to harvest, but one broker have problems with mice eating the mango in the storage. All brokers transport the mango. Three of them transport by donkey carts, where two of them also transport by human back. Two brokers transport the fruit by Izuzu trucks to other cities and the fruit lay loose on the trucks when they transport within the area where they harvest they transport by donkey carts. All brokers transport the mango in jute sacks when using donkey carts. The brokers have losses of mango during transport mainly due to compression and mechanical damages during loading and unloading.

All brokers sell mango to wholesalers at the central market in Addis Ababa located 252 km from Baco. Two of the brokers drive there themselves and the three others sell from the roadside after agreements with the wholesalers. One broker also sells to local wholesalers and another broker sells to both local wholesalers and local brokers. One broker also sometimes drives to a city in north Ethiopia located 1014 km from Baco and sells mango to wholesalers. The brokers measure quality of mango by looking at the color, size, physical condition and by touching the fruit. Also the production area and if it rains during ripening affects the quality of mango. Three of the brokers do not sort the mango in any way before selling. The other two brokers who do not sell to the local markets sort the fruit before selling it.

Three of the brokers believe that low prices are one of the greatest problems in the supply chain for mango. Other problems that are mentioned are lack of processing, low demand during fastening season and lack of transport to the central market in Addis Ababa. The brokers suggest that juice processing would add value and therefore improve the supply chain. To improve the market, one broker suggests that local brokers should start a cooperative to increase their bargaining power. That more wholesalers should come to the area with their trucks is desired by one broker. Other suggestions for improvement are cold storage that would extend the shelf-life of the mango. Four of the brokers thinks that wholesalers has the most influence in the chain and one broker believes that the brokers have the most influence.

5.2.3 Wholesalers

The wholesaler is the next actor in the supply chain for mango. All of the five interviewed wholesalers buy mango that is produced in south and west Ethiopia within distances of 251 km to 672 km from Addis Ababa. All wholesalers trade with brokers, but three of the wholesalers also buy directly from farmers. One wholesaler buys from state-farms and another wholesaler also leases mango trees sometimes. Two wholesalers buy a special type of mango, so called apple mango, from larger companies in east Ethiopia which are located 214 km from Addis Ababa. Four of the wholesalers buy mango every day during mango season and the fifth wholesaler buys mango two times per week. The amount of mango bought differs between 3375 kg - 26250 kg per time. All of the five interviewed wholesalers sell mango at Piazza, the central fruit market in Addis Ababa, to retailers, supermarkets, hotels, juice-cafés, individual customers and other wholesalers from Addis Ababa. One wholesaler also sells mango to wholesalers from a city in north Ethiopia with a distance of 770 km from Addis Ababa.

All wholesalers transport mango from the production areas to Piazza in Addis Ababa, but one wholesaler sometimes uses a broker for transportation instead. The mango is transported by Izuzu trucks and the fruits are laying loose on the truck. As shown in Figure A10 in Appendix 4 the largest average losses of mango for the wholesalers occur during transport. The wholesalers state that the losses are due to poor loading and unloading of the mango, over ripen fruit and compression damages.

Four wholesalers have a selling location at Piazza in Addis Ababa. Three wholesalers store the fruit in wooden boxes but one of them also have the fruit loose. The last wholesaler only has the fruit loose at the selling location. All four wholesalers have roof over the fruit, but one wholesaler has part of the mango in the sun at the selling location. Two wholesalers have a storage facility on Piazza, where one of them sells all fruit from this location. One of them store the fruit loose and the wholesaler that uses the storage as selling location stores the mango in wooden boxes.

None of the five interviewed wholesalers cool the mango. Even though the losses during storage and at the selling location are not as severe as during transport, as shown in Figure a10 in Appendix 4 all wholesalers have losses during these activities. The losses are mainly due to poor handling, mechanical damages, over ripen fruit and insects. The wholesalers measure quality of mango visually and by touching the fruit. Color, size and production area also have impact on the quality. There are no quality standards for mango in Ethiopia according to the wholesalers. One wholesaler says that the quality depends on the customer demand. Four of the wholesalers say that the broker or farmer sorts the fruit before transport and one wholesaler also sorts at piazza before purchasing mango. All wholesalers sort the mango in ripening stage during storage. One wholesaler also keeps different varieties separate.

The wholesalers believe that the greatest problems in the supply chain are poor harvest techniques, long distance to production areas and poor loading and transport. Other problems mentioned by the wholesalers are the brokers' power in the supply chain and poor quality of mango. The quality does not match the market demand according to the wholesalers.
To improve the problems on farm level, one wholesaler suggest governmental training for the farmers. Other suggestions are to improve the production management and handling of mango and that the producers should get access to improved varieties. Better packaging and transport is also suggestions for improvement. One wholesaler wants to exclude the brokers in the chain and have a more integrated chain with more farmers' cooperatives instead. Regarding the power in the chain three of the wholesalers think the brokers have the most power. The fourth wholesaler thinks it is brokers and themselves. The fifth wholesaler believes that no one has great power but that brokers have the most. There are no associations or organizations for wholesalers trading with mango according to the wholesalers.

5.2.4 Retailers

The retailer is one of the last actors in the supply chain before the end-consumer. All of the five interviewed retailers are located in Addis Ababa area and buy mango from wholesalers at Piazza. The mango is mostly produced in west and east Ethiopia within distances of 519 km and 672 km from Addis Ababa. One retailer also buys mango produced in south Ethiopia within a distance of 446 km from Addis Ababa. Three retailers buy mango from two up to four times per week and the amount differs between 100 kg- 500 kg per time. One retailer buy 50 kg mango every day and another retailer buy 100 kg mango once per week. All retailers sell mango to home consumers and three of the retailers also sell to restaurants. One retailer has hotels as customers and another retailer sells to juice-cafés. One retailer sells to other retailers. Another retailer also sells mango juice at the selling location. All customers are located in Addis Ababa.

Three retailers transport the fruit from Piazza to their selling locations within Addis Ababa area. Two retailers transport in pick-up trucks and one uses a minibus as transport mean. One retailer transports the mango in jute sacks and the other two uses wooden boxes. As shown in Figure A11 in Appendix 4 the losses of mango are small during transport. Only one of the

retailers has losses which are due to damage during loading. All retailers display the mango loose at the selling location, but three of them have the fruit outside under roof and the other two inside. Two retailers rent an additional storage where the mango is stored in wooden boxes. None of the five interviewed retailers cool the mango. The losses of mango are most severe at the selling location and storage, which is shown in Figure A11 in Appendix 4. Four of the five retailers have losses at the selling location and storage and the losses are due to over ripen fruit and mechanical damages. Two retailers say the mango is sorted in ripening stage and size by the seller. Four of the retailers sort and select the fruit themselves before buying. The retailers measure quality of mango visually by size, weight and ripening stage of the fruit. All retailers sort their fruit during storage. Two retailers only take away bad fruit and the other three retailers sort the mango in ripening stage. Two retailers have the ripe mango on top of the unripe mango.

Four retailers state that the greatest problems in the mango supply chain are the brokers. According to the retailers the brokers hamper the information between farmers and wholesalers. Suggestions to improve the situation are; to form cooperatives for farmers in order to exclude the brokers, retailers should buy directly from the farmers and the government should interfere. One retailer thinks that the wholesalers should have their own packaging and take a larger part in the chain. Three of the retailers think the brokers have the most power in the supply chain and the fourth wholesaler believes it is the wholesalers. The fifth retailer thinks it is the farmers that have the most power. There are no organizations or associations for mango retailers according to the interviewed retailers.

5.2.5 Restaurants

The restaurants are one of the last actors before the end-consumer in the supply chain for mango. The five interviewed restaurants are located in Addis Ababa area. One restaurant buys mango from a supermarket and another restaurant buys mango from a supermarket or fruit retailers near the restaurant. Two restaurants purchase their mango at Piazza and always buy from a regular wholesaler. The fifth restaurant has a purchaser who buys mango at Piazza. Four of the restaurants say that their mango is produced in south of Ethiopia and the fifth restaurant does not know where the mango they use is produced. One restaurant buys 2 kg-3 kg mango every day and another restaurant buys 15 kg- 20 kg mango once per week. The other restaurants buy mango two to three times per week and the amount differs between 20 kg- 50 kg. All restaurants sell mango as juice. One restaurant also sells mango in fruit salads and another in fruit punch.

Four of the restaurants transport the mango themselves. Three of them transport in a van, minibus and car. Two of them use plastic boxes for the mango during transport, but one of them sometimes uses plastic bags. The third retailer transports in wooden boxes. One restaurant buys mango close by and walks with the fruit packaged in plastic bags. The fifth restaurant gets the mango delivered from a supermarket and the fruit is packaged in plastic boxes and covered in plastic. None of the restaurants have any losses during transport

All restaurants store the mango. One restaurant keep the whole mangoes loose on a shelf in a storage room and the sliced mango in a fridge. Another restaurant stores the mango in a freezer with a temperature of -20 ^{o}C. The third restaurant keeps the ripe mango in the fridge and the unripe fruit in a storage in plastic boxes. The fourth restaurant stores all mangos loose in a fridge with a temperature of +5- +10 ^{o}C. The fifth restaurant is part of a restaurant chain and therefore share a larger storage where the mango is kept before delivered to the restaurants. At the restaurant the fruit is stored in a drawer with bar cases and the juice is stored in a fridge. Two of the five restaurants in the mango supply chain have losses during

storage, though in very small quantities, due to over ripening. The restaurants measure the quality of mango visually and by touching the fruits. Three restaurants say that the mango is sorted by the seller before buying. The fourth restaurant does not know if the fruit is sorted and the fifth restaurant says the fruit is not sorted. Four restaurants also sort the mango themselves before buying. One restaurant trusts their seller regarding the quality and do not sort the fruit.

One restaurant thinks that poor storage and that no one cares about the quality of mango are the greatest problems in the supply chain. Another restaurant says the low supply during low mango season is a problem. Poor handling of the fruit and packaging are also mentioned as great problems. To improve the problems in the chain and to minimize the losses of avocado the restaurants suggest; better handling of the mango in the whole chain, better packaging and transport with cooling system. One restaurant wants to exclude the middlemen and think that the farmers should deliver directly to restaurants and hotels. One actor says that all actors should send back poor fruit to the previous actor. Another suggestion is that the government should implement standards and rules in the chain to improve the problems. Regarding the power in the supply chain two restaurants believe the wholesalers have the most power. The third restaurant thinks it is the brokers and the fourth restaurant says all actors have the same power. The fifth restaurant believes wholesalers and large farms have the most power.

5.3 Prices in the supply chains of avocado and mango

5.3.1 Avocado Prices

The average prices for avocado on each actor level were calculated and can be seen in Figure A12 in Appendix 4. The interviewed actors bought and sold avocado in different measurements units, therefore all prices were converted into ETB per kg in order to do a comparison of the prices in the study. Only the farmers selling price are shown since the production costs found in the study were difficult to calculate. The bars representing brokers' prices in Figure A12 is only showing prices for the brokers who buy and sell avocado. The brokers who work as a link between wholesalers and farmers get paid by both parties or only by the wholesalers. The total amount varies from 50 ETB to 300 ETB per time. On the restaurant level only the prices for avocado juice is shown in the figure.

The actors in the avocado supply chain think that the prices are affected by supply and demand, quality, variety, size of the fruits and fastening season. The payment procedure varies from direct payment to payment after a few days up to one month. Agreements between the actors occur on all levels and written contracts are used to some extent for example when farmers trading with the farmers' association. One broker says even if an agreement is made the parties can change the prices sometimes and sees this as a great problem. Trust plays a large role in some cases and the actors only make agreements if they trust the other party. One wholesaler does not pay until the quality of avocado is examined at the central market. Regarding the price information in the chain actors on all level have ways to find out prices in advance by calling different actors or by investigating the supply and demand in the chain. One restaurant has a six months price agreement with their wholesalers. On all levels in the supply chain there are also actors that do not have a way to receive price information.

5.3.2 Mango Prices

In the mango supply chain farmers lease out their trees and the leasing prices for one tree per year varies from 10 ETB/year to 80 ETB/ year. The brokers say that they lease mango trees for prices between 100 ETB/year- 400 ETB/ year for one tree. The average prices for mango on each actor level were calculated and can be seen in Figure A13 in Appendix 4. The interviewed actors bought and sold mango in different measurements units, therefore all prices were converted into ETB per kg in order to do a comparison of the prices in the study. The production costs found on farm level in the study were hard to estimate therefore only the farmers selling prices are shown. On the restaurant level the actors buy mango unprocessed and sell it as mango juice and some actors also sell mango in fruit salad or fruit punch, only the prices for juice is shown in the figure. The type of mango found on the farm and broker level in this study are in focus in the result and analysis. Some of the wholesalers and retailers also trade with another variety of mango called Apple mango and this variety is larger in size and the prices are higher. On the wholesale level the average purchase price is 10.5 ETB/kg and the selling price for apple mango is 15, 5 ETB/kg. On the retailer level the average purchase price for apple mango is 17. 5 ETB/kg and the selling price is 23.75 ETB/kg.

Agreements between the actors occur on all levels and they are foremost of informal character. The brokers make oral agreements with the farmers at flowering time in February to March. The payment procedure varies from direct payment to payment after a few days up to one month. Some of the farmers leasing out their trees get paid at the time of the advance agreement and some farmers get paid after the leaser has sold the harvested fruit. Regarding the price information in the chain actors on all level have ways to find out prices in advance by calling different actors or by analyzing the market situation. One restaurant has a three months price agreement with a supermarket. On all levels in the supply chain there are also actors that do not have a way to receive price information.

6 Analysis and discussion

The first section presents the constraints for the value and supply chains of horticulture products in Ethiopia and the constraints describe the conditions of the markets. In the next part, the empirical information found in this study is analyzed and discussed according to the literature review and the theoretical framework value chain analysis for developing countries.

6.1 Value chain Constraints

6.1.1 Market access

The supply chains for mango and avocado in this study can mostly be described as an A-system in Ruben et al. (2007) different sub-systems. The A-system exists of small-scale producers (Ruben et al., 2007), which according Emana & Gebremedhin (2007) is the case for horticulture products in Ethiopia. The A-system according to Ruben et al. (2007) distributes to local markets and a majority of the producers of mango and avocado interviewed in this study sells to local markets. The products in this study are though often distributed from local markets to larger markets such as the big fruit market in Addis Ababa. This suits well with the A-system as the system aims at a local market but can often be part of other market system, usually through middlemen. Few of the producers interviewed in this study are members of an association or cooperative but producers in a B-system are often tied to each other in cooperatives, associations or other types of contracts. The B-system also mainly targets supermarkets (Ruben et al., 2007), which is not the case for the supply chains studied as they mainly target local markets. Furthermore the C-system is mainly concentrated on export (Ruben et al., 2007), which is not the case for the supply chains in this study. To conclude, the supply chains for mango and avocado in this study are best described as A-systems.

As an A-system they are often low-income chains with low added value and the value being shared between many actors (Ruben et al., 2007). Emana and Gebremedhin (2007) confirms this in a study of the horticultural market in eastern Ethiopia, stating that other than the added value of the products moving closer to the consumer there is little added value to be recognized. The producers often have low market information (Ruben et al., 2007), which is confirmed by Mulat (2000) who states that producers have low bargaining power in agricultural supply chains in Ethiopia. Emana & Gebremedhin (2007) also state that the producers have a low amount of information as the farmers and traders often do not have any direct communication with each other but only through a broker.

As mentioned earlier the market for horticultural products in Ethiopia usually does not create any added value other than moving the products closer to the consumer (Emana and Gebremedhin, 2007). With limited information systems being one of the largest constraints for agricultural markets in Ethiopia (Mulat, 2000) together with a large number of middlemen limiting the information flow (Emana & Gebremedhin, 2007) the level of market orientation, according to Ruben et al. (2007), in supply chains for horticulture products in Ethiopia can be assumed as low.

6.1.2 Infrastructure and resources

According to Trienekens (2011) there are four main constraints faced by markets in developing countries regarding resources and infrastructure. The first constraint is low access to input resources. Both the mango and avocado producers in this study have low access to

pesticides, and especially the mango producers' state that there is a great need of this. Another input missing in the supply chains are improved varieties of both mango and avocado trees. The improved varieties can both improve the quality of the fruit and make the harvesting procedures easier. The second constraint is the geographic position of many producers where they have a long distance to central and valuable markets. The central market for horticultural products in Ethiopia is in the capital Addis Ababa, and none of the actors know of any other valuable market or distribution center in their areas. This means that all the produce that is not sold to home consumers at local markets needs to be distributed to Addis Ababa from large parts of the country.

The third constraint is lack of human resources in form of educated labor and knowledge. This can be seen as a constraint in the studied supply chains as the actors state that they believe there is a lack of knowledge regarding handling of the fruit, and that better education in this area is a way to minimize the losses and improve the supply chains. The last constrain concerns lack of technology, both for production and distribution purposes. None of the interviewed actors use any kind of technology, such as cooling, equipment that can control the ripening of the fruits or mechanized harvesting tools. A large amount of losses in the chains are due to lack of these kinds of technologies, and many actors state that this can be a way to improve the chain.

Besides from these four constraints there is also a lack of adequate infrastructure both regarding information and distribution. That the products are distributed in an efficient way are an elementary condition for a chain to develop. Many of the actors in the studied supply chains state that lack of and inadequate transportation are large problems in the supply chain. Many producers do not have access to roads where any other transportation means than donkeys can be used. Information infrastructure is another important condition for a supply chain to develop.

The only mean of information sharing in the supply chains studied are mobile telephones, which is not accessible for all actors. There is also a problem with information sharing in the chains, as some of the actors state that there is low cooperation between actors. Many actors in the supply chains also state that there is a great lack of markets and a lack of buyers, such as wholesalers, on the local markets. Another problem stated, foremost by the producers, is that the buyers from central market do not come to match the harvest time and periods with high supply.

6.1.3 Institutional voids

Scientists from different fields (McDermott, 2002; Stark, 1996; Fligstein and Mara- Drita, 1996; North, 1991) have agreed that it is the government in a country that is responsible for building and maintaining institutions. Many of the 60 interviewed actors express a wish for the government to interfere in both supply chains. The wishes are to organize the markets with such things as better storages and loading and unloading docks. Another part where there is a wish of interference by the government is regarding the brokers, who act as middlemen. Many other actors state that these have too much influence in the chain, where some express that they need to be more organized and others that they need to be removed from the supply chain. These statements from the actors show that there is a lack of formal institutions and that the actors believe that it is the government's duty to implement these, but it should be noted that this void could be filled by private organizations. Therefore, with greater knowledge among the actors regarding private organizations the void could be filled without interference from the government.

One type of private institutions is business groups, or associations, which are often needed when governments cannot live up to their expectations (Khanna & Rivkin, 2001; World Bank, 2002). Only four of the 60 interviewed actors are members of and have access to an association. Even though there is a great wish from many producers to have access to an association for farmers, this in order to strengthen their bargaining power and increase prices. As business groups only are willing to fill the void of governments if it is profitable, it can be assumed that it is not profitable with producer cooperatives in Ethiopia. This mostly as there is a wish but it is still not fulfilled. If producers thought that they could raise the prices with cooperatives and organizations there should not be a lack of them, as it is today. Even though it could be profitable with business groups, especially among farmers, they need to have the right conditions to fill the void. There are no informal cooperation's found among the farmers in the study, which could be a required condition in the long run to start formal cooperation's.

6.2 Supply chain activities

6.2.1 Supply chain activities

To have improved and grafted tree varieties in the production of mango and avocado have many advantages compared to seeded trees, such as easier harvesting and better quality of the fruit. In the two supply chains investigated in this study only three avocado producers have grafted trees. The producers themselves state that the lack of improved and grafted varieties is due to low access. With access to these the losses during harvest would decrease and the quality of the fruit would increase. Better quality of fruit is an improvement request from actors all threw both chains. As both mango and avocado trees are draught tolerant they foremost need irrigation during the juvenile period and dry seasons. All the avocado farmers that use irrigation are restrictive and half of them do not water the trees at all, which according to Chaka (pers. com., 1, 2014) is good as they therefore avoid fungus related to over watering. Three of the mango producers follow recommendations regarding irrigation (Singh et al., 2013), as they only use irrigation during the juvenile period. The rest of the producers use irrigation on all trees all year around. The producers that only use irrigation when there is a need have an advantage as they lower the costs for water, generators and labor.

The avocado producers do not have any problems with the most known post-harvest diseases. The producers instead have problems with other diseases, but they do not know the name of them or how to treat them. Here is a gap of both knowledge and resources, as the producers cannot treat the diseases without the right education and pesticides. As one of the farmers that have both local and improved varieties only has problems with the diseases on the local variety, more of the improved varieties could be a solution for this problem. The same problem, lack of knowledge and pesticides, is also found among the mango producers. They have problems with a pest, that they believe is a fruit fly, but do not know for sure what kind of pest it is and have no access to pesticides.

To pull the fruit from the tree, which is the harvesting method practiced by the respondents, can be analyzed as the best practice for both mango and avocado producers. This mostly as it saves both money and time compared to clipping (Hofman et al., 2013). None of the farmers experience the disadvantages with pulling the fruit from the tree, such as scars where the stem was situated or damage on the skin (Hofman et al., 2013). One disadvantage with pulling the mangos from the tree is that the stem is not left on the fruit, and this often results in sap burn (Johnson & Hofman, 2009). This is though solved by the farmers in the study by drying the fruit in the sun for up to one hour, but this can result in quality decrease as the fruit never should be exposed to direct sun light (Johnson & Hofman, 2009). A solution to this is to dip

the mango into alkaline detergents directly after harvest (Johnson & Hofman, 2009). The question here is though if the producers have knowledge about or access to these kinds of detergents and if they do the next question is if they can afford it.

A great problem found among the producers of both mango and avocado is that the fruit falls to the ground when it is pulled from the tree. To come back to the issue that improved varieties and grafted trees are lacking among the farmers, this is a solution to this problem. As these trees are smaller and therefore can be harvested by hand this problem is dramatically reduced. Another solution suggested both by Chaka (pers. com., 1, 2014) and interviewed farmers are to have a small bag on the harvesting stick that the fruit instead falls into. As the farmers that have access to these tools claim that their losses have been reduced by a great deal it can be a good way to reduce the losses in the beginning of both chains. The fruit that do not crack and therefore is not a loss for the producers can obtain mechanical damages that instead is noticed later in the supply chains, therefore implementing harvesting tools with a bag can decrease losses further down in the supply chain as well.

According to the literature review it is difficult to determine the maturity of both mango and avocado, and therefore when it is time to harvest (Crane et al., 2009; Hofman et al., 2013). As it differs between trees and fruits on the same tree the practice of looking at the color and size used by the producers in this study can be assumed as a good way. It is mentioned among the actors in both supply chains that losses of fruit occur due to harvesting of immature fruit. According to the farmers the reason is not mainly that they intend to harvest immature fruit, but that immature fruit falls from the tree when other fruit is harvested. Whit this said more focus should lay on new harvesting practices instead of new practices to measure maturity of the fruit. All the farmers in both supply chains harvest in the morning and do not leave the fruit on the field for longer than two hours, which is also according to recommendations (Hofman et al., 2013; Hardy et al., 1995; Yahia, 2011).

When fruit is packaged both during storage and transport the most important things to focus on are that the packages are well ventilated and to avoid mechanical damages and compression (Thompson & Mitchell, 2002; Hofman et al., 2013). A majority of the actors, package mango and avocado in jute sacks which fails in both ventilation and to protect the fruit from mechanical damage and compression. When the fruit is in poor ventilated packages it ripens faster, which both lowers the storage-life and increases the risks of mechanical damages. Many actors also both transport and store the fruit without any packaging. The fruit on the top are in this case well ventilated, but for the fruit in the bottom the scenario is worse. Without any packaging the fruits are not protected against compression. Packages that is not used in such a great extend is plastic and wooden boxes. These are smaller than the jute sacks, with a maximum of 25 kg, which lowers the risk of damaging other fruit during loading as they are dropped on each other. These packages are also ventilated and strong enough to protect the fruit. The plastic and wooden boxes also protect the fruit from vibration and abrasion during transport as they are smaller. With an extended use of plastic and wooden boxes the losses during storage and transport, including loading and unloading, can be decreased.

When the main goal with transportation is to minimize the losses of products, it is important to have a transportation mean that is fast and where damages on the fruit are avoided. The most common transport mean in the first level of the chains in this study is donkey and donkeys with cart. This is not a fast way to transport, as it is the same speed as walking or slightly faster. The longer time the transport takes the larger the risk is for the fruits to ripen. An example of this is that the avocado farmer with the longest distance to the local market is also the one with largest losses, this due to over ripening. The transportation can also be somewhat bumpy which increases the risk of mechanical damages. It is though difficult for

some of the farmers to change transport mean, as the roads can only be used by animals, humans or motorcycles. It is also difficult as a truck or a car is much more expensive than a donkey, and is therefore not possible for all farmers to purchase. Further down in the chain it is most common with Izuzu trucks, fitting 3750 kg of fruit. These are not suited for transportation of fruits as they are not closed trucks and therefore have no ability to be part of a cold chain. Some of the actors cover the fruits, whilst other leave the fruits exposed to sun and rain during the transport. As mentioned earlier the fruits are sensitive to both rain and direct sunlight, and therefore to cover the trucks could be an easy way to lower losses during transport.

Cooling is used in a very limited extent in the supply chains and over ripening is stated as a big problem at all stages in the supply chains. Mango is though sensitive to chilling injuries (Singh et al., 2013), which is therefore avoided. To implement a cold chain would probably lower the losses substantially but large investments would be required, as both new transport means and storage facilities are needed. No other technology to extend the shelf-life of the fruits are used in the studied supply chains, but cooling can be seen as the most important first step to upgrade the supply chain and other technologies only as a further step in the long run future. Some of the actors further down in the supply chains use plastic or paper coverage to speed up the ripening process of the fruits, which can be seen as a good alternative in these low-income chains when advanced technology can be too expensive to implement

6.3 Value chain analysis

6.3.1 Network structure

The actors found in this study of supply chains for avocado and mango are; farmers, brokers, wholesaler, retailers, restaurants and consumers. The same actors where found in the study by Emana and Gebremedhin (2007) on the horticultural market in eastern Ethiopia. They described four levels in the marketing channel; producers, the middlemen/brokers, traders (retailers, wholesalers and exporters) and consumers. Except for exporters all these actors are represented in the studied supply chains. The network structure in a value chain is dependent on what market channel (s) the actors have chosen (Trienekens, 2011). Available market channels for a firm to sell their products or services depend on the limitations to get market access. In this case the actors are part of both local market channels and national market channels and the constraints to get market access are discussed in subsection 6.1.1. The vertical connections can follow all steps in a chain or skip steps (Trienekens, 2011). As shown in Figure 4 the ties differ among the actors and some avocado and mango go through all levels and some products go through less intermediary steps. All actors except the brokers and restaurants have various kinds of customers. It varies if the actors trade with the same buyers or sellers and therefore the strength of the vertical ties also varies. On farm level in the mango supply chain, four farmers say that they always trade with the same wholesaler, which seems as a strong tie but according to the farmers there are no other options available. Also on the restaurant level trading with the same sellers is common.

When it comes to horizontal connections in the value chain for avocado there is a strong collaboration among the farmers in the Yirga Alem area, where they have formed a farmers' association. Four of five interviewed farmers in that area are members of the association. The association transports and sells their members avocado at the central market in Addis. Strong collaboration in a horizontal tie can stimulate and enable market access and market information (Trienekens, 2011). In this case the association gives the farmers a more secure trading partner with fixed prices and access to a larger market. On the other horizontal levels in the avocado supply chain no organizations or association have been found. There are no

official cooperation's in form of organizations or associations found in the mango supply chain. On the retailer level there are informal connections, for example as one retailer states that the retailers in the same area cooperate regarding transport. On the broker level two drive around together in the area to find farmers.

6.3.2 Value adding activities

No value adding activities of avocado or mango take place at the farmer, broker or wholesaler level in the supply chains and the products are sold unprocessed. The value of the fruits increases when the products move closer to markets with high demand. In this case it means when the fruits are transported from the production areas to the market in Addis Ababa. This can be seen when looking at the average prices for unprocessed mango and avocado in Figure A12 and A13 in Appendix 4. The retailers' average selling price for avocado is 12.10 ETB/kg. This is 6.87 ETB/kg higher compared to the average selling price per kg received by the avocado producers which is 5.23 ETB/kg. In the mango supply chain the retailers' average selling price is 9.70 ETB/ kg and the producers sell mango for 1.94 ETB/kg in average. The difference is 7.76 ETB/kg between the producers and retailers average selling prices. The average purchase and average selling prices in the mango supply chain increase on each level when moving from the farmer to the end-customers. In the avocado supply chain it increases from the farmer to the broker level and from the wholesale to the restaurant level. The chains can mostly be described as an A-system as earlier mention in subsection 6.1.1 An A-system has several actors and therefore the added value is shared between many actors. The actors in the avocado supply chain think the prices are affected by supply and demand, quality, variety, size of the fruits and fastening season. The actors in the mango supply chain think the prices are affected by supply, production area, ripening stage of the fruit, access to transport and weather conditions. These factors may explain some of the price differences.

How the value added is distributed is affected by the comparative advantages and bargaining conditions possessed by the actors in a value chain (Lazzarini et al., 2001). In these chains the retailers, wholesalers and restaurant have an advantage by acting on the central market with more potential customers and higher demand compared to the producers and brokers acting on smaller markets with fewer customers. This may explain some of the differences in the average prices between the actors. The farmers and in most cases the brokers are also dependent on the customer coming to their area to buy fruit and therefore have lower bargaining conditions. Some brokers in the mango supply chain and the avocado association in Yirga Alem area buy larger quantities of fruit and rent trucks and sell fruit on the central market in Addis. The larger quantities on the wholesale level and in some cases on the retailer level may be an advantage as they transport fruit by their own or rented trucks and are able to buy fruit from different areas with various quality and prices.

One retailer and all restaurants sell an added value product in form of avocado and mango juice and the prices are significantly higher compared to the prices for unprocessed fruit. The average selling price for one glass of avocado juice is 10. 85 ETB higher than the average purchased price per kg avocado. For one glass of mango juice the average selling price is 14.72 ETB higher than the average purchased price per kg mango. One factor affecting the size of value added is dependent on the end-customer's willingness to pay (Trienekens, 2011). In Addis Ababa it can be assumed that there is a demand and higher willingness and ability to pay for value added products. This compared to the local markets where the farmers and brokers act where it can be assumed that the demand for juice is lower.

In food chains it is safety and quality of the products that are in focus in value adding processes (Trienekens, 2011). Quality of a product can be measured by the color, taste and tenderness etc. or by characteristics of the product process such as fair trade or organic

production. The quality in the studied supply chains is measured visually and by touching, the taste is not mention as a way to measure quality. Large size fruit is considered as good quality in the chains. Quality and durability of avocado are dependent on many factors (Ruben et al., 2007). Handling, transport and storage are discussed in section 6.2. The production area and variety also have impact on the quality. Actors in both chains say that the quality has impact on the prices and they take various prices for different types of fruit.

To improve quality and food safety in production and handling of food several standard quality assurance systems and certification systems can be implemented (Trienekens & Zuurbier, 2008). But these standards are not implemented in developing countries to a large extent. In this study the interviewed actors say that there are no official quality standards for fruit that they know of in Ethiopia. Actors on all levels sort avocado and mango to some extent and they take various prices for different kinds of fruits. However, there is no official grading system in the chains according to the actors. To have a relevant and commonly used grading system in the supply chains and to sort fruit according to the system can increase the value of unprocessed food products (Ruben et al., 2007). It can also enable actors to capture more value added in the chain by then having access to more markets and customers with different demands.

6.3.3 Governance structures

All of Williamsons (1999) three general governance types; spot- market relationships, hybrid governance forms and vertical integration are found in the supply chains for avocado and mango. The governance forms in all levels of the supply chains are mainly spot market relationship and hybrid governance forms with informal and formal contracts. One retailer in the avocado supply chain is a supermarket and is part of a firm with an integrated supply chain and receives fruit from the supermarket's own farm. Agreements between the actors occur on all levels and most agreements are oral and informal. Written contracts are used to some extent, for example the farmers trading with the farmers' association for avocado. Most of the agreements are made on short notice. One exception is in the mango supply chain where brokers and wholesaler make oral agreements with the mango producers when the trees are in flowering stage. On the restaurant level in each chain there is long term price agreements. The payment procedure varies from direct payment to that the parties get paid after a few days up to one month. One wholesaler does not pay until the quality of avocado is examined in order to safe guard against opportunistic behavior. Trust plays a great role in the chains investigated in this study. Some of the actors points out that they only make agreements if they trust the other party. In the mango supply chain where informal long-term agreements are made, one broker states that the farmers are considered as trustful. Relational contracts based on trust and reputation is common in value chains in developing countries where written contracts are not used in a large extent (Ruben et al., 2007).

The characteristics of the transactions between actors in a value chain have impact on the governance structures (Trienekens, 2011). There are different types of transaction costs according to Ruben et al (2007); ex-ante costs and ex-post costs. The transaction costs found in the studied supply chains are mostly ex-ante costs, due to searching for potential exchange agents which are done on most levels by both the seller and the buyer. When the brokers are used as link to find sellers for the wholesalers and to make agreements it saves time and money for the wholesalers if the relationships are efficient. Some actors always trade with the same buyers and/or sellers which can lower the transaction costs. In developing countries there often a high level of uncertainty in business relationships caused by factors such as unbalanced trade relationships and poor physical infrastructures (Trienekens & Willems, 2007; Trienekens, 2011).Uncertainty in the studied supply chains occurs in forms of poor

market places for the farmers with no access to places where the fruit is protected from sunlight and rain. One wholesaler also mentions this as a problem since no farmers appears at the market places if the weather is poor. It can be a risk that payment in many cases takes place after the purchase of the avocado or mango and no formal contract exists. One broker says that parties can change the prices after an agreement is made and sees this as a great problem.

It is important that the information exchange between the actors in a supply chain is efficient (Trienekens & Willems, 2007). Regarding the information about the prices in the avocado and mango chains the actors on all levels have ways to get price information. They use different strategies such as calling or asking other actors on different levels in order to find out about the prices. There are connections between the production areas and mostly wholesalers from the central market in Addis Ababa. Some actors also say that they analyze the market situation and therefore can estimate the prices. In both chains there are also actors on each level that do not have a way to find price information and there is a similar situation in both chains.

That all actors do not have a way to receive price information is a problem in the chains. In the mango supply chain the brokers are seen as the greatest problem, they are too many and hamper the information between farmers and wholesalers. In the avocado supply chain one broker says that the supply and demand do not match in the supply chain due to poor information exchange and one of the restaurants points out the lack of information and knowledge in the supply chain as the greatest problems, especially on farm level. There is lack of knowledge about handling avocado among the farmers and they do not receive any price information from other actors. Information asymmetry between actors, unclear market structures and poor communication infrastructures hamper the information exchange in many chains in developing countries (Trienekens & Willems, 2007). Lack of information exchange especially regarding demand can also cause post-harvest losses in supply chains for fresh produce (Shukla & Jharkharia, 2013). In this chain it seems like actors on all levels are trying to have an information exchange about the prices for fruit but not all actors have the possibility or connections to be able to do that. The large number of intermediaries can be a problem where the information goes through many steps and can be constrained on the way. This is a common problem in supply chains for fresh produce in developing countries where there are several intermediaries between the producer and consumer (Shukla & Jharkharia, 2013).

The choice of governance structure is affected by how dependent the actors in the value chain are on each other and the variances in market power (Trienekens, 2011). One actor with a lot of market power can determine the governance mechanisms (Ruben et al., 2007). In this study it is the brokers and wholesalers that seem to have the most power and influence in the chains regarding information and prices. These are the actors which are pointed out by the interviewed respondents to be the most powerful actors. The problems mentioned by the respondents are; that the brokers and wholesalers do not come at the right time to the production areas, they control the prices and receive most of the profits in the chain. Another uncertainty mention on the retailer level is that the brokers do not deliverer fruit when agreed. In the mango supply chain four of the farmers always sell to the same wholesaler. One of the farmers believes it is a forced monopoly and that the wholesaler has stopped other sellers from coming to their area. This can be seen as a case where one powerful actor determines the market conditions for other actors. It seems difficult for the farmers to find other buyers and decrease the power of this wholesaler if they do not collaborate.

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6.4 Upgrading

6.4.1 Upgrading network structure

The same actors are found in both the mango and avocado supply chains; farmers, brokers, wholesalers, retailers and restaurants. The vertical connections are also similar and can vary from following all steps to straight ties between for example a wholesaler and a farmer. When it comes to the market situation foremost farmers and brokers wants more buyers in their areas and access to more markets. Improvements of the conditions and organization at the local markets are mentioned as suggestions to improve the supply chains. The management and conditions at the central market at Piazza also needs to be improved according to the actors. If large wholesaler markets consistently can provide and deliver standard products at favorable prices they can be part of upgraded chains and meet new requirements (Humphrey, 2007). In order to do that investment in market infrastructure needs to take place to improve and maintain hygiene and storage conditions. If the wholesalers at the central market in Addis Ababa want to take part in upgraded chains these improvements are required. These improvements are also needed to minimize the losses on the wholesale level.

Formation of cooperatives, producer associations or public- private relationships can be a way to upgrade horizontal relationships in value chains in developing countries (Narrod et al., 2009; Roy and Thorat, 2008; Sáenz-Segura et al., 2007). The market problems in the investigated chains can be improved by forming cooperatives for farmers. The farmers think that the prices and market access can be improved by this and wholesalers and retailers desire to buy from farm cooperatives or association instead of brokers. The interviewed farmers in Yirga Alem area were members of a farmers' association. These farmers stated that their situation has improved since they became members. The association has fixed prices and was a secure trading partner. Furthermore the farmers were not dependent on the brokers as before. Horizontal collaboration can furthermore contribute to decrease losses in horticultural supply chains (Kader, 2004). The farmers deliver avocado to the association two times per week. The association facilitates storage and thereafter transport to the central market in Addis Ababa. Improved packaging in forms of plastic boxes and harvesting sticks with an attached bag are provided from the association to their members. All these factors are important in order to minimize losses of horticultural products (Kader, 2004). Other horizontal collaborations on all levels such as associations and other organizations can be ways to improve the information flow and knowledge in the chain.

6.4.2 Value added

In both chains the farmers get a small part of the value. More horizontal collaboration in forms of farmers' cooperatives can be way to improve this situation, this by increasing the bargaining power of the farmers and their possibility to sell to other markets. More horizontal collaboration can also decrease the number of intermediaries in the chains. No major value adding activities is undertaken by any actors in the chains. Juice processing in the production areas is suggested as a way to add more value to the products and improve the supply chains. One broker also thinks that a close located juice processing industry would compensate for the lack of markets to sell to. Juice processing has increased in developing countries and can be a way to capture more value in a supply chain (Dolan and Humphrey, 2000). In the latter stages on the retailer and restaurant levels juice is sold for higher prices than unprocessed fruit. It will however be difficult for a single or a group of farmers or brokers to start a juice processing factory without help with investments. To sell juice on the local markets is a way

to upgrade for the farmers or brokers. However, the demand for juice and ability to purchase added value products may be low on the local markets.

There are no quality standards for fruit in Ethiopia according to the actors. To be able to improve safety and quality in food supply chains certification and quality assurance systems plays a great role (Trienekens & Zuurbier, 2008). To implement a grading and sorting system can also be a way to increase the value of the fruits (Ruben et al., 2007). Actors on all levels sort mango and avocado but there is no official grading or sorting system. Some actors also desire quality controls at the markets. All production is organic and this can in the future be valuable if aiming for export markets or other markets which have demand for organic products. Other improvements in the chains are also needed to increase the quality of fruits and to decrease the losses. This includes improvements regarding packaging, handling, transport and storage facilities. These are important factors in order to increase quality of the fruits and minimize losses of fresh produce (Kader, 2004). Information and knowledge how to handle and maintain quality of horticultural products are central aspects that need to be improved in many developing countries. This is also the case for the studied supply chains, more information and knowledge in the chains is needed regarding the best handling practices the chains is needed regarding the best handling practices for mango and avocado.

6.4.3 Upgrading of governance structure

The governance forms in the supply chains for mango and avocado are spot-market relationships and hybrid governance forms. Only one actor was found to be part of an integrated chain. The transactions on some levels take place several times per week and with a high degree of spot-market relationships. The transaction cost for searching for buyers and sellers are therefore high. To increase the trading with the same actor could lower these costs. Informal agreements are used to a large extent and seem to be successful in some cases. The brokers, for example, say that the mango producers are very trustful and oral agreements works well. But other actors state that prices can be changed even after contracts are made. Better forms of contracts can be a way to improve this.

The brokers' power is seen as a problem by many actors. In supply chains for fresh produce in developing countries the great number of intermediaries is a problem since the information gets hampered between producers and consumers (Shukla & Jharkharia, 2013). Therefore small-scale producers are in many cases dependent on intermediaries to get market access and inputs. This is the case for some of the mango farmers where they are forced to sell to one wholesaler and have no other options. Horizontal collaboration is an important driver to increase the bargaining power of small-scale producers or actors (Ruben et al., 2007; Trienekens, 2011). Cooperatives or other horizontal collaboration can be way to improve the situation in the investigated chains in this study.

Regarding the information flow there are actors that do not get any price information and this needs to be improve in order to increase the information flow in the chain. An improvement regarding the information exchange in value chains is the use of cell phones which have increased among producers in developing countries and enabled them access to better market information (Trienekens & Willems, 2007; Ruben et al. 2007). This is also the case in the studied chains as the actors calls other actors to receive price information and communication by mobile phone is also used when making agreements. Digital market information can be a way to improve the information flow in the supply chains.

7 Conclusions

In this chapter the aim and research questions will be answered and solutions for the problems will be presented. The aim for this study is to explore the supply chain and post-harvest losses for mango and avocado in Ethiopia.The actors identified in the supply chains for avocado and mango are farmers, brokers, wholesalers, retailers, restaurants and consumers. The only formal horizontal relationship found is an avocado farmers' association. No value adding activities take place on the farmer, broker or wholesale level. Two retailers and all restaurants sell avocado and mango juice as value added products. The governance forms are mainly spot-market relationships and hybrid forms of governance. Contracts and agreements are used in the chains but are foremost of informal character. Price information is flowing through the chain but do not reach all actors and the information flow between the actors need to be improved.

The largest losses of avocado and mango in the supply chains occur at:

- Harvest, mainly due to poor harvesting techniques
- Transport; mainly due to loading and unloading
- Storage; mainly due to over ripening

These losses can mainly be decreased by:

- Implementing improved varieties that are grafted
- New harvesting tools where the fruit is collected in a small bag
- Increased usage of plastic and wooden boxes
- Introduction of cold chain management

To upgrade the supply chains for mango and avocado the actors' require more trading partners, improved organization and conditions both at local markets and at the central market. In order for these changes to be possible, the integration in the chains should be increased. To upgrade horizontal relationships formation of farmers' cooperative or association or other forms of collaboration are suggested as ways to improve the supply chains. This can decrease the dependency and the influence of the brokers in the chain which are seen as a great problem. Activities such as coordination of selling, transport and access to improved harvesting tools and packaging were also provided by the farmers' association and can be a way to increase quality and decrease losses. Juice processing is suggested as a way to add more value to the products. Grading systems and quality standards can be implemented to improve the quality of mango and avocado and to reduce the post-harvest losses in the chains. More formal contracts should be introduced to lower the uncertainty in the chains.

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Personal messages

Chaka, A., researcher at Ambo University, Department of plant science
1. Personal message, 2014- 03- 07
2. Personal message, 2014-03-11

Gebresenbet, G., Professor at Swedish University of Agricultural Sciences, department of Energy and Technology, personal message, 2014-03-11

Appendix 1: Questionnaire farmers

1. a) How much land do you have?
b) How many trees do you have? Where are they located?
d) Are your trees grafted or seeded? What variety are the trees?
c) Do you use irrigation?
2. a) How high is your yield /year?
b) Does the quality vary? Why?
3. a) Do you have problems with any diseases and pests?
b) And if so how do you treat the diseases?

Harvest

4. a) Do you harvest yourself or do your rent out your trees?
b) When during the year do you harvest?
c) How do you choose when to begin?
5. a) Do you harvest at a specific time of the day?
b) Do you harvest all fruit at the same time?
6. a) How do you harvest the fruit?
b) What kind of tools do you use?
c) Is the stem left on the fruit?
d) Do you have problem with sapburn? (only asked the mango farmers)
e) Does the fruit fall to the ground after picking?
f) How long does it take from the first tree to the last?
g) How are the fruit stored on the field?
7. a) Are there any losses during harvest?
b) What causes them?
c) How big are they in kg?

Storage

8. a) Do you treat the fruit in any way?
b) Do you store them?
9. a) In what kind of facility?
b) How is the fruit packaged when stored?
c) How long do you store the fruit?
d) For how long can the fruit be stored with acceptable quality?
e) Do you have any costs from keeping the fruit in storage?
10. a) Do you cool the fruit?
b) At what temperature, how long, how quickly after harvest?
11. a) Are there any losses during storage?
b) What causes them?
c) How big are they in kg?
12. a) Do you sort the fruit?
b) How do you sort them?
c) If graded, do the price differ for different classes??

Transport

13. a) Do you transport the fruit?
b) How do you transport?
c) How far? How long time does it take?
d) Who operates and owns the transport?
e) What are the costs for transport?
f) How big is the transport?
14. a) How are the fruit packed during transport?
c) Do you cool the fruit during transport?

15. a) Are there any losses during transport?
b) What causes them?
c) How big are they in kilos?

Selling

16. a) Where do you sell the fruit?
b) Who do you sell the fruits to?
17. a) How much do you sell each time?
b) How often do you sell?
18. a) Do you find the buyers or do they find you?
b) Do you make agreements with the buyers in advance?
c) When do you receive the money?
19. a) Are the fruits sorted at market place? By whom?
b) How are they sorted, graded or only good or bad?
20. a) At what price do you sell the fruits per kg?
b) How much does it differ?
c) What affects the price?
d) Do you have any way to find out the prices in advance? How?
21. a) Are there any losses in conjunction with selling?
b) What causes them?
c) How big are they in kilos per day?

General questions

22. a) Is this a viable business for you?
b) What do you think are the greatest problems in the supply chain?
c) What do you think could be improved?
d) What do you think could be done to minimize the losses in the supply chain?
e) Who do you think has the most influence in the chain?
23. a) Are there any cooperatives or other organizations for you?
b) If yes, are you part of any cooperative or organization?

Appendix 2: Questionnaire wholesalers, retailers and restaurants

Buying

1. a) Where do you buy fruit? Does it differ?
b) Who do you buy fruit from?
c) Where is the fruit you buy produced?
2. a) How much fruit do you buy per time?
b) How often do you buy?
3. a) Do you find the sellers or do they find you?
b) Do you make agreements with the sellers in beforehand?
c) Which group, buyers or sellers are the most in number?
4. a) Are the fruit sorted by the seller?
b) Do you sort the fruit before buying?
c) How are the fruit packaged when you buy it?
5. a) At what price do you buy the fruits per kg/kuntal?
b) How much does it differ? Max, Min?
c) What affects the price?
d) Do you pay different prices for different classes/ quality of fruit?
e) Do you have any way to find out about the prices in advance?
f) When do you pay for the products you buy?
g) How do you measure the quality?

Further questions regarding transport, storage, selling and general questions were asked. The same questions were asked these actors as the farmers, see Appendix 1, question 8 a) – 23 b).

Appendix 3: Questionnaire brokers

The following questions were asked to the brokers that only participate in the agreement procedure between the farmers and brokers:

1. a) Do you physically handle the fruits?
2. a) what is your role in the chain? What is your tasks?
b) How do you get paid?
c) How much?
d) Do you find the sellers or do they find you? How?
e) Are the parties present during the agreement?
f) What affects the price?
3. a) Is this a viable business for you?
b) What are the greatest problems in the supply chain?
c) What do you think could be improved?
d) Who do you think has the most influence in the chain?
The brokers that buy and sell fruit were asked the same questions as the wholesalers, see Appendix 2.
The brokers that lease trees and therefore both harvest and sell fruit were asked the same questions as the farmers, see Appendix 1.

Appendix 4: Figures

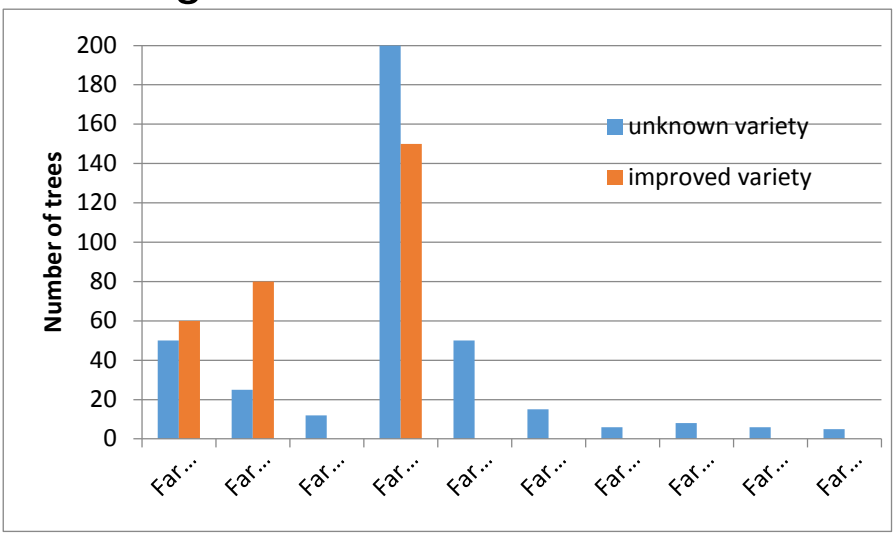

Figure A1. Number of avocado trees per farmer

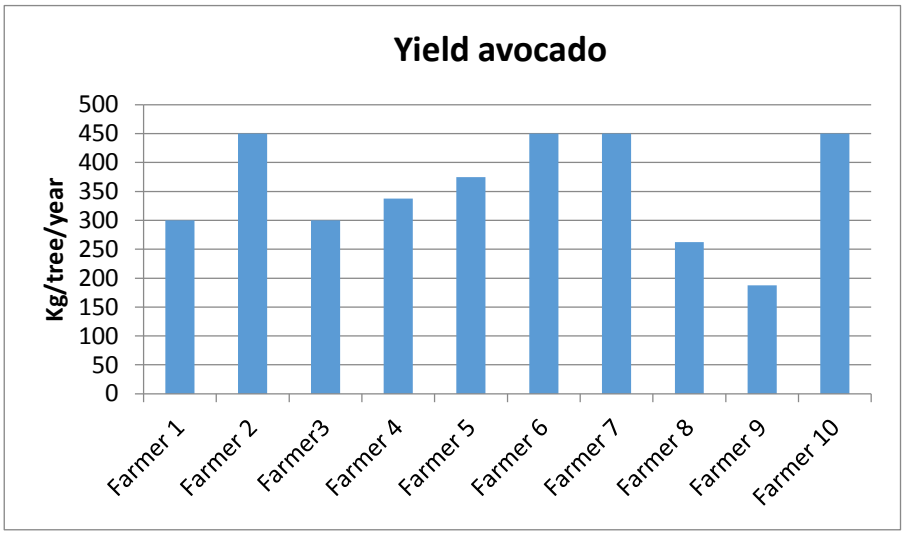

Figure A2. Yield of avocado in kg per tree and year

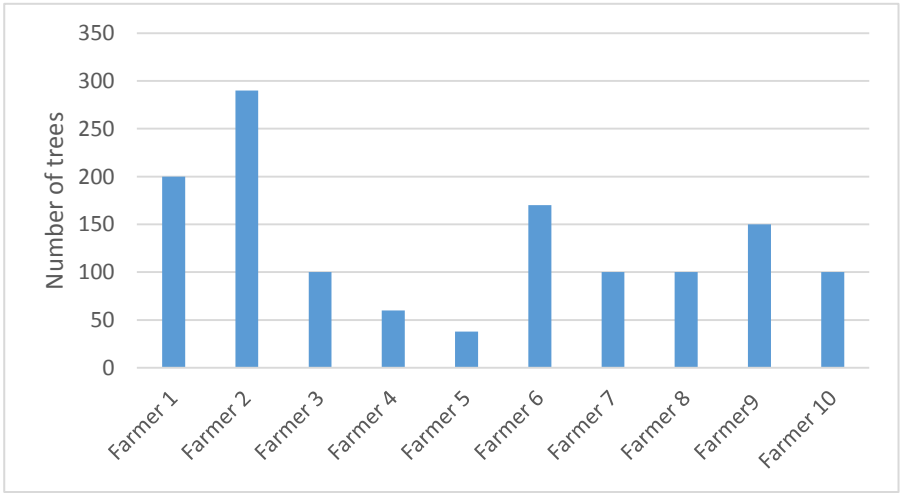

Figure A3. Number of mango trees per farmer

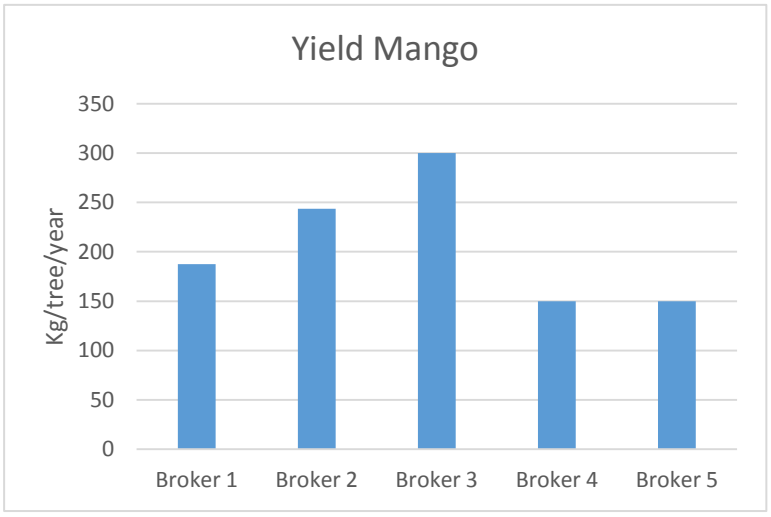

Figure A4. Yield of mango in kg per tree and year

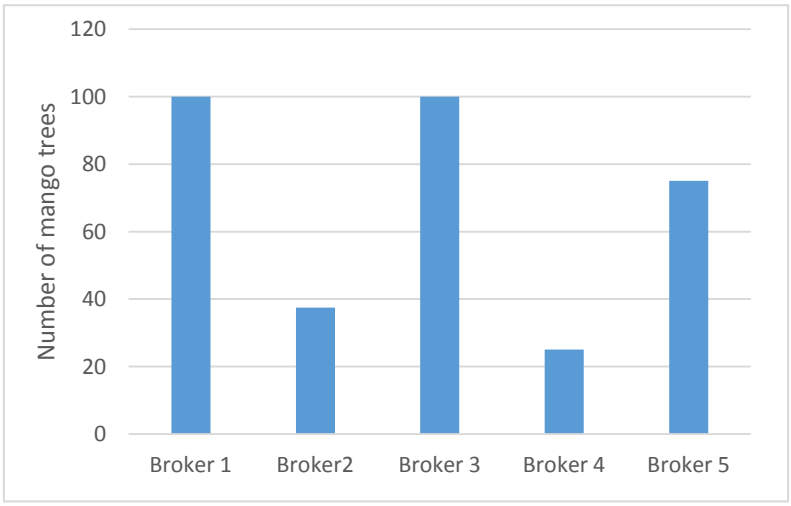

Figure A5. Number of rented mango trees per broker

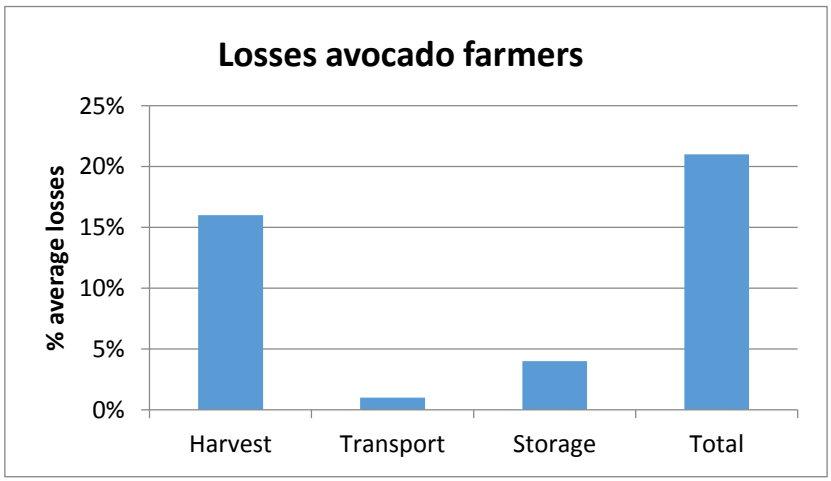

Figure A6. Average losses of avocado stated by the avocado farmers, own processing. The losses are presented in percentage of the total amount harvested avocado.

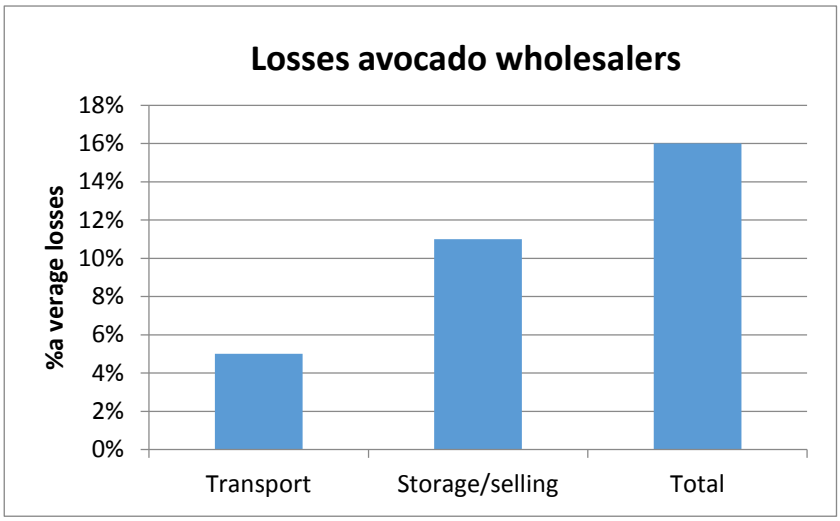

Figure A7. Average losses of avocado stated by the wholesalers trading with avocado, own processing. The losses are presented in percentage of the total amount of purchased avocado

Figure A8. Average losses of avocado stated by the retailers trading with avocado, own processing. The losses are presented in percentage of the total amount of purchased avocado.

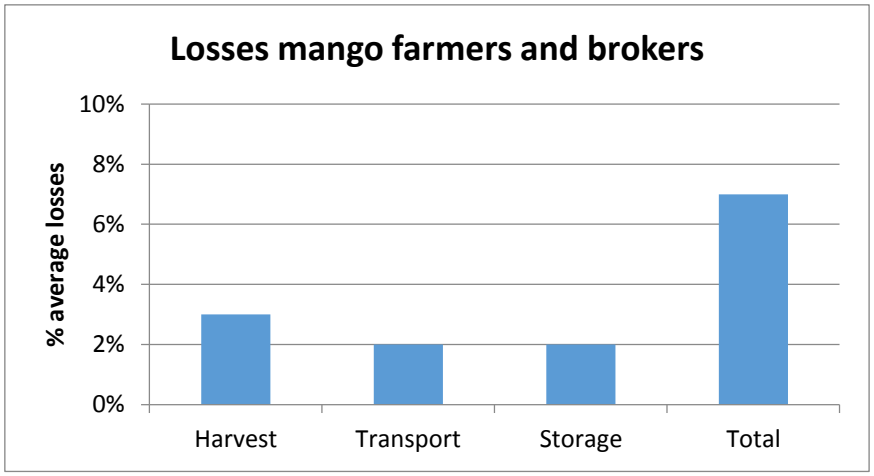

Figure A9. Average losses of mango stated by farmers and brokers harvesting mango, own processing. The losses are presented in percentage of the total amount harvested mango.

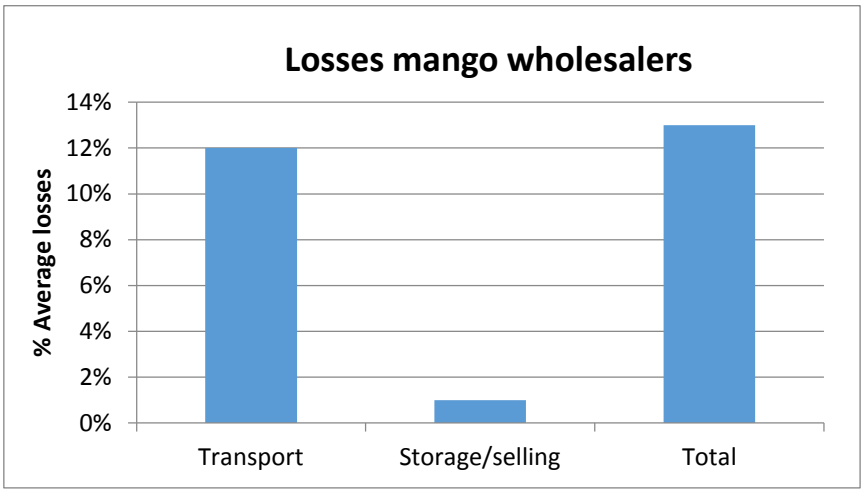

Figure A10. Average losses of avocado stated by the wholesalers trading with mango, own processing. The losses are presented in percentage of the total amount of purchased mango.

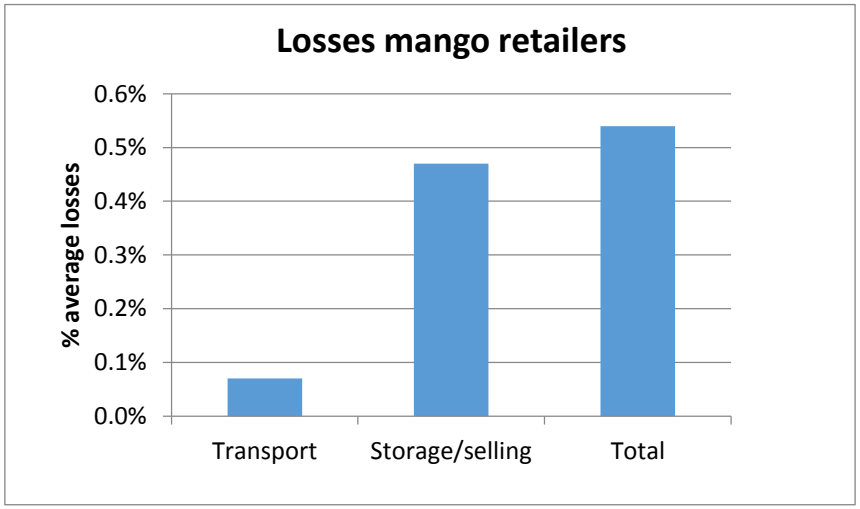

Figure A11. Average losses of avocado stated by the retailers trading with mango, own processing. The losses are presented in percentage of the total amount of purchased mango.

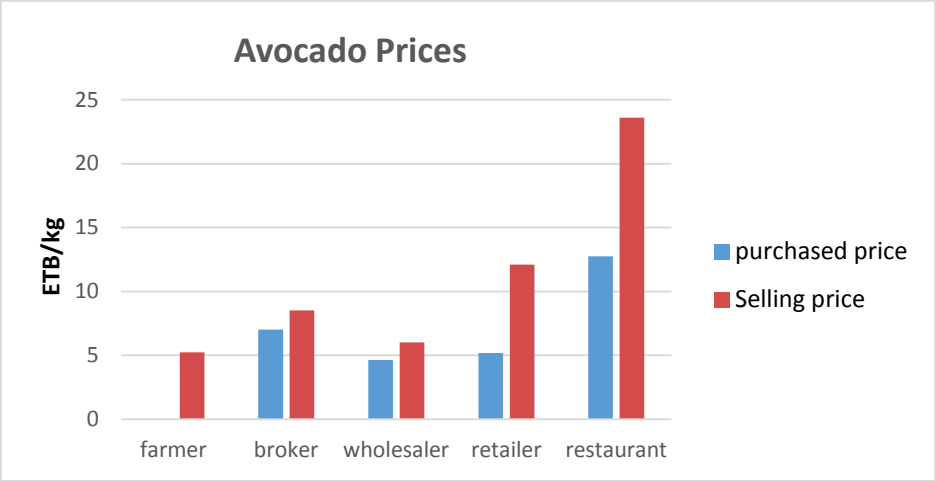

Figure A 12. Average purchased and selling prices per kg for the actors in the avocado supply chain

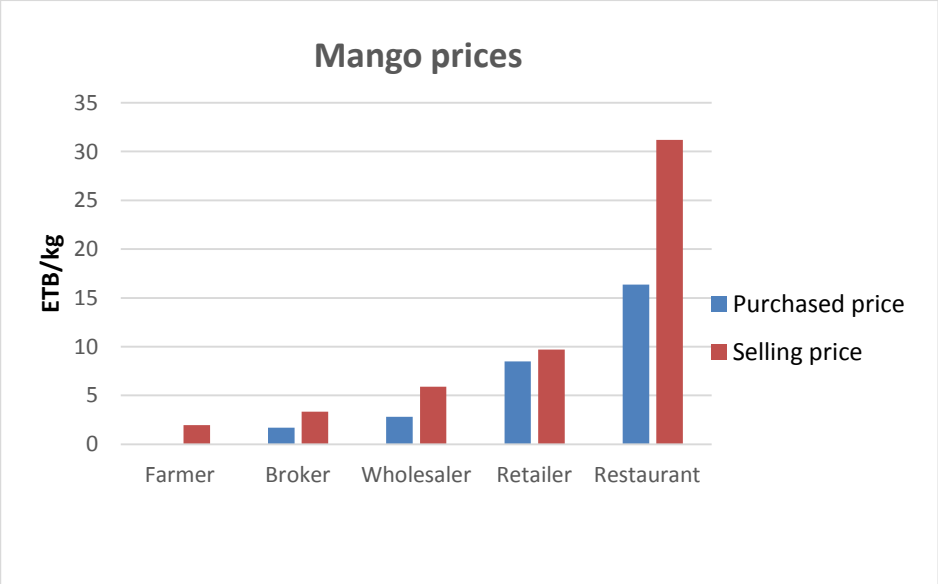

Figure A13. Average purchased and selling prices per kg for the actors in the mango supply chain.