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Cover: Onion taken from the soil at an onion farm near Meki, Ethiopia. 2013. Photo: Stefan Fors

ABSTRACT

Ethiopia is a developing country situated on Africa's horn. Ethiopia ranks 173rd on United Nations human development index where the least developed country ranks 186. About 85% of all Ethiopians are employed in agriculture. Onion is one of the basic ingredients in the Ethiopian cuisine and thus an important crop. Previous studies on fruits and vegetables in Ethiopia points at post-harvest losses between 15% and 70%. To estimate the losses for onions in Ethiopia a supply and value chain analysis has been made. A literature review on supply chain management, value chain analysis, onion cultivation, and agricultural and logistical conditions in Ethiopia has been made in order to acquire a holistic view of the topic. Interviews with aid from interpreters have been made to gather the necessary information from the chain actors. The chain actors have been identified and the losses at each level of the chain quantified and analyzed. The value chain for onions in Ethiopia has been researched to identify the different actors and their activities carried out when the onions move from producer to consumer. All expenses related to the activities in each step has been studied to find the value added and to calculate the profit for each actor. The complete chain consists of six actors; farmer, broker, transporter, wholesaler, retailer and consumer. The onions can reach the end-consumer without passing through all steps; broker, transporter and retailer are not always involved.

The conclusions from the supply chain analysis were:

- The total amount of losses in the chain is about 13% and most of these losses occur at the end of the chain at consumer level.
- The supply chain of onions is fragmented and thus not an integrated logistic system.
- The fragmentation of the chain causes a non-collaborative system, which in turn results in higher losses at the end of the chain.

The conclusions of the value chain analysis were:

- The use of fertilizers and pesticides has a major impact in the value chain but differs widely between the farmers. A more controlled and effective use can have positive effect on both the economy and the environment for the farmer.
- The actor making the biggest profit is the wholesaler. The farmers have a higher profit per kg of onions, but the fact that they only get three harvests per year makes the annual profit low. The wholesalers have (by far) the highest sale rate and the second highest profit per kg.
- The wholesalers are not following the tax-regulations. None of the wholesalers include 15% VAT as a standard procedure, which they should. VAT is only added when the customers want a receipt. Only three of the nine wholesalers pay tax on their profit.
- Wastes from onion production at farmer level can be used to produce electricity corresponding to 5.7% of the total electricity consumption in Meki and Ziway.

SAMMANFATTNING

Etiopien är ett utvecklingsland som ligger på Afrikas horn i nordöstra Afrika, Etiopien rankas på 173:e platsen i FN:s index för mänsklig utveckling, där det minst utvecklade landet rankas som nummer 186. Cirka 85 % av alla etiopier arbetar inom jordbruket. Lök är en basingrediens i det etiopiska köket och är därför en viktig gröda för bönderna och befolkningen. Tidigare studier på frukt och grönt i Etiopien pekar på fysiska förluster mellan 15 % och 70 %. För att uppskatta de förluster som finns för lök i Etiopien har en analys på Supply Chain och värdekedjan gjorts. En litteraturstudie om Supply Chain Mangement, värdekedjeanalys, lökodling, samt jordbruksförhållanden och logistiska förutsättningar i Etiopien har gjorts för att erhålla en helhetssyn på ämnet. Intervjuer med hjälp av tolkar har gjorts för att samla in den nödvändiga informationen från aktörerna i kedjan. Värdekedjan för lök i Etiopien har undersökts för att identifiera de olika aktörerna och deras aktiviteter som utförs för att löken ska komma från producent till konsument. Alla utgifter kopplade till de olika aktiviteterna i varje steg har undersökts för att hitta värdeförändringen och för att beräkna vinsten för varje aktör. De aktörer som finns i kedjan har identifierats och förlusterna på varje nivå i kedjan kvantifierats och analyserats. Hela kedjan består av sex aktörer; jordbrukare, mäklare, transportör, grossist, återförsäljare och konsument. Löken kan nå konsumenten utan att passera genom alla steg; mäklare, transportör och återförsäljare används inte alltid.

Slutsatserna från Supply Chain Management analysen är:

- Den totala mängden fysiska förluster i kedjan är ca 13 % och de flesta av dessa förluster uppstår i slutet av kedjan på konsumentnivå.
- Leveranskedjan av lök är fragmenterad och är inte ett integrerat logistiksystem.
- Uppdelningen av kedjan medför ett icke - samverkande system, vilket i sin tur leder till högre förluster i slutet av kedjan.

Slutsatserna av analysen av värdekedjan är:

- Användningen av gödningsmedel och bekämpningsmedel har stor inverkan i värdekedjan men skiljer sig stort mellan bönderna. En mer kontrollerad och effektiv användning kan ge positiva effekter på både ekonomin och miljön för jordbrukarna.
- Den aktör som gör störst vinst på löken är grossiten. Jordbrukarna får den högsta vinsten per kilo producerad lök, men det faktum att de bara får tre skördar per år gör den årliga vinsten låg. Grossisterna har överlägset störst försäljningsgrad och näst högst vinst per kg
- Grossisterna följer inte skattereglerna. Ingen av grossisterna inkluderade 15 % i mervärdesskatt som standardförfarande, vilket de borde. Mervärdesskatt läggs bara på när kunderna kräver kvitto. Endast tre av de nio grossisterna betalar vinstskatt.
- Restprodukter från lökproduktionen hos jordbrukarna kan användas till att producera el motsvarande 5,7 % av den totala elanvändningen i Meki och Ziway

EXECUTIVE SUMMARY

The supply chain analysis showed that the total post-harvest losses for onions from farmers in the areas of Meki and Ziway to consumers in Addis Ababa are about 13 %. Most of these losses occur at the end of the chain at consumer level. The logistic system is not integrated; the chain actors act solitary, which give a fragmented chain. The end result of the fragmented chain is a non-collaborative system with higher losses at the end of the chain. The value chain analysis showed that the wholesalers are the chain actors who make the highest annual profit. The farmers have the highest profit per kilogram of onions but a much lower sales rate than the wholesalers. The use of fertilizers and pesticides differs widely between the farmers and has a large impact on the value chain. A more controlled and effective use can have positive effect on both the economy and the environment for the farmer. In the value chain analysis, it was found out that the wholesalers do not follow the tax-regulations. None of the wholesalers included the mandatory 15% VAT as a standard procedure; VAT was only added when the customers wanted a receipt.

PREFACE

Supervisor for this thesis is David Ljungberg and the topic examiner is Girma Gebresenbet, both situated at the Department of Energy and Technology at Swedish University of Agricultural Sciences (SLU), Uppsala. Hanna Daniels and Stefan Fors have carried out all the research work in collaboration. The literature study and the writing of the report have been divided between the two students; Hanna Daniels has been responsible for the supply chain analysis and Stefan Fors for the value chain analysis. The research is done as part of the SIDA funded project “African Fruits”, which is a cooperation between Swedish University of Agricultural Sciences and Addis Ababa University.

ACKNOWLEDGEMENTS

We would like to send our warmest thanks to our supervisor at Addis Ababa University, Dr. Bikila Teklu and our contact at Ambo University, Mr. Ashenafi Chaka. They both made us feel very welcome to Ethiopia and provided valuable support and help in the production of this report. We would like to thank all the translators; Meklit Berihun, Adam Aberra, Nebiyou Tereffe, Jibril Akmel, Wassihun Namssi and Latera Malikamu. We would also like to thank Dr. Berhanu Assefa, Dr. Tesfaye Belami and Dr. Mulugeta Negeri, who are employees at Addis Ababa University and Ambo University, for their involvement in our project and other support during our stay in Ethiopia. Thanks to the SIDA funded project "African Fruits" and the Linneus-Palme stipend, which without we would not have been able to do this thesis. Last but not least, thanks to our supervisor at Swedish University of Agricultural Sciences David Ljungberg and our topic examiner Girma Gebresenbet.

Hanna Daniels and Stefan Fors

Uppsala, June 2014

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1. INTRODUCTION

1.1 BACKGROUND

In Ethiopia, post-harvest losses for fruits and vegetables are estimated to range between 15% and 70% according to previous research in the project *African fruits*. Ethiopia at the same time is ranked as one of the poorest countries in the world by the UNDP-index (United Nations Developing Programme, 2013). About 85% of the employments in Ethiopia are in the agricultural sector, which accounts for 46% of the GDP. This makes it the most important occupation, but it also makes the country's economy vulnerable when harvests are destroyed due to drought or exceeding water amounts during the rainy periods (CIA, 2013). Onions are one of the most important ingredients in the Ethiopian kitchen and used especially during fasting times, when the people who fast only eat vegetarian food. Fasting occur every Wednesday and Friday and during longer periods, for example, around Christmas and Easter. Onions are low value products but important for many farmers in Ethiopia. Therefore, there is a need to review the onion chain to quantify the losses and trace where and why they occur, which can be done by Supply chain management approach and value chain analysis. These approaches provide tools to analyze the flows in the chain and weak points may be detected so that the chain can get optimized. With these approaches the security of the supply might increase, providing more secure sales for the producers and also bring food safety for the consumers. This research is done as part of the African fruit project, which is a collaboration between Swedish University of Agricultural Sciences and Addis Ababa University where the field research was conducted.

1.2 PURPOSE

The purpose of the study is to investigate and understand the current logistic chain for fruits and vegetables in Ethiopia. The knowledge from the study will be used to try to suggest solutions of how to reduce unnecessary losses and also how to increase the economic profit.

1.2.1 Main objective

Main objectives are to map out all steps in the logistic chain for onions in Ethiopia to produce a supply chain management and value chain analysis to reduce postharvest losses. To achieve the main objectives, these specific objectives were established:

- Identify all actors in the chain from producers in Meki and Ziway to consumers in Addis Ababa
- Quantify onion losses
- Identify where in the chain the losses occur
- Analyze why the losses occur
- Identify value adding activities for all actors
- Analyze the added value in each step of the chain

1.2.2 Limitations of the study

Due to time and resource constraints the research was limited to include only the onion producing areas around Meki and Ziway since they are located near Addis Ababa. Only a small number of about two to ten interviews were carried out in each sector of the chain and with randomly chosen interviewees. The extent at consumer level has been decided to only contain restaurants since the time limit made it impossible to do a broader investigation of the consumers. The restaurants are all situated in the capital of Ethiopia, Addis Ababa.

2. LITERATURE REVIEW

The literature review covers supply chain management, value chain analysis, onion cultivation, and also relevant agricultural, logistical and general conditions in Ethiopia. The literature study has been made in order to grasp the holistic view of the topic, provide a deeper understanding and to give information to relate back to later in the research.

2.1 CURRENT CONDITIONS IN ETHIOPIA

2.1.1 General information about Ethiopia

Ethiopia lies in the north east part of the African continent where it is the most populated country after Nigeria. The landscape of the country consists mainly of high plateaus with mountains and valleys. The climate is monsoon tropical with a wet and a dry season. The big variation in altitude also gives variations in the climate throughout the country. The mountain areas have cold climate whilst it is warmer in the lowland. The annual precipitation varies from year to year, but also by region. Some regions are more vulnerable to drought then others. Ethiopia has had years with extreme drought. When crops are being destroyed due to lack of water, starvation comes as a result (Globalis, 2013).

Ethiopia is the only country in Africa that has not been colonized, though it was occupied by Italy from 1936-41 (CIA, 2013). Haile Selassie was the emperor from 1930 until he was deposed by a military junta in 1974 when critical voices grew during a famine in the country. Violence against dissidents, years of drought and famine, led to the collapse of the military regime 1991 (Sida, [no date]). Today Ethiopia is a federal republic, with elections every fifth year. The Prime Minister is elected in the parliament and is head of the government. The country is divided into nine states and two city-areas where (in theory) most of the politic power is carried out, but in reality the power is mostly concentrated to the government party Ethiopian People's Revolutionary Democratic Front. The democratic system is questionable and violations of human rights do occur (Landguiden, [no date]).

The population is close to 94 million, of which 17 % lives in urban areas and 39 % lives below the poverty line (US$1.25/day). The population increases with about two million per year. The official national language is Amharic, but several other languages are spoken in different regions throughout the country (CIA, 2013). Even though Ethiopia has experienced a

strong economic growth in the latest years, the country is still one of the poorest countries in the world and heavily dependent on aid and loans from developed countries (Globalis, 2013). In a report on human development made by the UN in 2013, Ethiopia is on 173rd place out of 184 listed countries. This shows that the progress in welfare is slow, despite of a strengthening of the economy (UN, 2013). The infrastructure is poorly developed. The limited transport facilities affect the economic growth when resources can't be transported. Almost all transports of people and goods are made using the road network (Landguiden, [no date]).

Coffee has long been Ethiopia's most important crop and tops the list of exported products. In later days oilseed has run up to be almost as important export product as coffee (Landguiden, [no date]). The main trading countries are China, Germany and USA. All land is owned by the state and farmers can only lease the land. Leasing certificate is issued in some areas and gives the tenants strengthened rights to use the land over a longer period (CIA, 2013). Poor infrastructure has made it difficult to extract the big amount of mineral resources that the country holds, from which mainly gold is extracted today (Globalis, 2013). The electricity consumption per capita in Ethiopia was 60kWh in 2012 (EIA, 2012) and hydro power is an important resource for electricity production. Ethiopia is now constructing a dam in the Nile-river from where electricity, enough for the own country as well as export to neighboring countries, will be produced. The dam is controversial due to environmental issues, not only in Ethiopia but also in other countries affected by the Nile-river.

2.1.1 Taxes

The value added tax – VAT, is a percentage of the selling price, added in each step of the supply chain. It is said to be a consumption tax, since the final tax payer is the consumer. When a company buys goods and services needed for their business, VAT is paid to the supplier. When the company sells the products or services, they charge their customers with VAT. The amount of tax that has to be paid to the government is what the company has charged their customers minus the paid VAT when they bought the material needed for their own business. In the end, this means that the whole amount is paid by the consumers. (Herouy, 2004).

The VAT system in Ethiopia was introduced 2002, became effective January 1st 2003 to replace an old sales taxation system. The VAT rate is 15 percent and added to all trades including taxable products and services. (Ethiopian Government Portal [no date]). Persons, companies and organizations that carry out economical activities on a continuous and regular basis with an annual turnover exceeding 500,000 ETB (1 USD ~ 20 ETB) have to register to pay VAT (Yesegat, 2008). There are transactions that are free from VAT, for example medical, financial and religious services (Ethiopian Revenues and Customs Authority [no date]). Companies shall also pay tax on the profit made. Corporate businesses pay 30 percent while the tax rates for individual businesses extend from 10 up to 35 percent. (Jemaneh [no date]).

2.1.2 Infrastructure

The road infrastructure has gone through major improvements in recent years. The government put one quarter of the total infrastructure budget into road projects to repair, upgrade and build new roads. A road fund has been created, funded by a fee included in the fuel price, to guarantee money for road maintenance **(**Ethiopian Government Portal [no date]). Ethiopia is land-locked and uses Djibouti´s harbor for import and export of goods, this means road transportations with heavily loaded trucks over long distances. The poor infrastructure together with high transportation costs has affected the economic growth negatively. That is why Ethiopia now is planning new railway projects with a total length of 5,000 km, which will be completed by 2020 **(**Southworld web magazine, 2013). The most important project is the railway connecting the capital, Addis Ababa, with the harbor in Djibouti. The project, which is planned to be completed in 2016, will move the heavy road borne traffic to the railway (Jeffrey, 2013). There will be a double track railway connecting Addis Ababa with Adama (107 km) and a single track from Adama to Djibouti (549 km). The location of the cities are shown in Figure 1. The project will not only result in less road traffic, it will also reduce the travel time by half. Passenger trains will also serve between the cities along the railway (Ethiopian Radio and Television Agency, 2013).

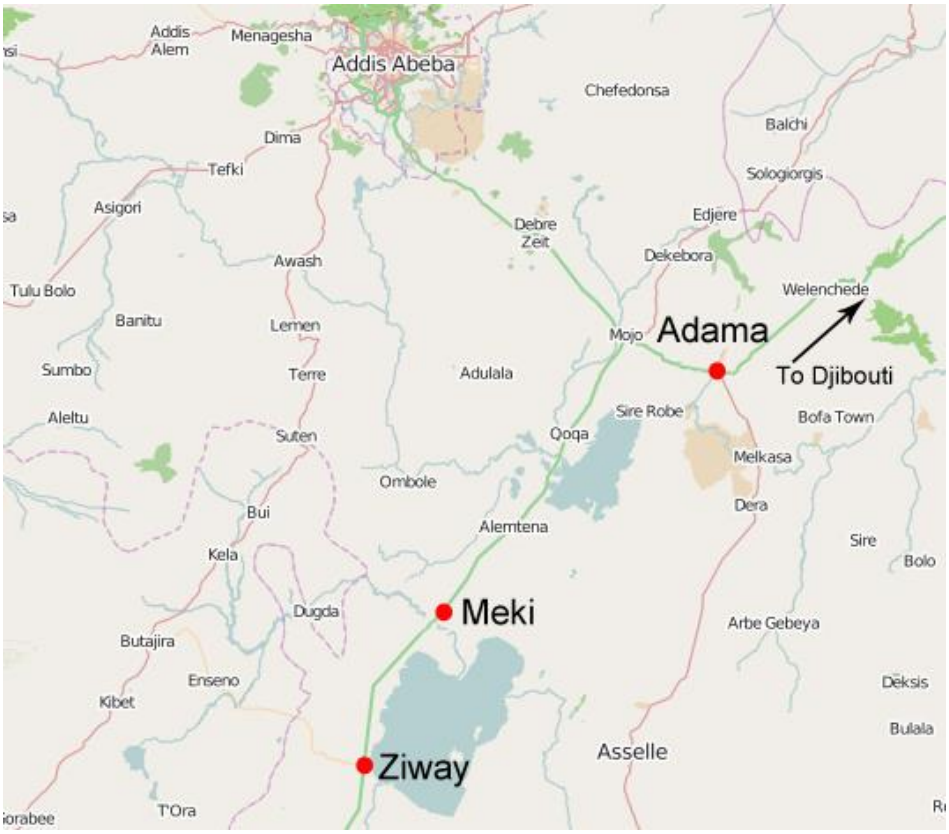

Figure 1: Map of Ethiopia with the road system between Addis Ababa and the onion areas. (openstreetmap.org)

A new expressway has been built between Addis Ababa and Adama and will open up for traffic in April 2014 as the first tolled road in Ethiopia. The existing road is part of the Addis Ababa – Djibouti route and is one of the busiest in Ethiopia with about 20,000 vehicles per

day (roadtraffic-technology.com, [no date]). The vehicles share the roads with pedestrians and animals with nothing in between to protect them from accidents. Ethiopia has a high number of traffic accidents with fatalities compared to the number of registered vehicles in the country. The World Health Organization report 6.83 deaths in traffic accidents per 1000 vehicles in Ethiopia during the year 2010, which can be compared to Sweden where the corresponding figure is 0.05 deaths per 1000 vehicles (WHO, 2013). The new Addis Ababa – Adama expressway will be fenced on both sides to protect people and animals along the road to decrease the number of accidents. Other benefits are lower fuel consumption and shorter traveling time with the new 20 km shorter road (roadtraffic-technology.com, [no date]).

The onion areas, Meki and Ziway, are located southwest of Adama. The transportation between the farming areas and the capital uses a big part of the road between Addis Ababa and Adama. The infrastructure projects mentioned above will therefore have positive effects on the transports of agricultural products to Addis Ababa. There is also a planned project to build an expressway from Majo (between Addis Ababa and Adama) to Hawassa (110 km from Ziway). This means that the transportation of onions from the Meki and Ziway area can in the future be made by using the expressways (African development bank group, 2013)

The traffic in the city of Addis Ababa is congested and slow-moving with frequent traffic jams. The city has problems with noise and air pollution, yet there are no controls on the vehicles to minimize the issues. Passenger and smaller freight transportation is carried out with buses, minibuses and taxis (Ethiopia Ministry of Transport, 2011). A light railway network is now under construction within Addis Ababa and will start to operate in 2015. The railway's capacity will be 80,000 passengers per hour during the busiest hours. The electric railway is described as eco-friendly since it does not add any air pollution in the city (Mulatu, 2014).

Ethiopian Telecommunication Corporation introduced mobile phone service in the year of 1999 by building a GSM network that could hold 36,000 subscribers (Negi, 2009). The network has since then been expanded and today holds about 25 % of the population in Ethiopia. Ethio Telecom has monopoly on mobile communication. The lack of competition might explain the poor quality of the network (The Economist, 2013). In a study on the mobile network quality made by Rakshit Negi in 2009, more than half of the respondents answered that the network quality was below average (Negi, 2009). The Ethiopian government is accused for not being willing to let go of the monopoly because they want to control the people's communication (The Economist, 2013).

2.2 ONION PRODUCTION

Onions are cultivated in many regions of the world, but mainly on the northern hemisphere. Onions are part of the Liliaceae family, of the genus *Allium* that contains several hundreds of species (Shigyo and Kik, 2008, p.121). The Latin name of the most common onions worldwide is *Allium Cepa,* which includes the red and yellow onion. *Allium Cepa* is the second most popular vegetable in the world following tomatoes (Desalenge and Aklilu, 2003, p.2).

2.2.1 Cultivation

Onions are treated as an annual crop even though it is biennial. The seed production requires two seasons since it takes one season for the onion to produce dry bulbs and another season for the production of the flower stalk, from which the seeds are harvested. Temperature is the one environmental factor that has the highest impact of onion growth. The optimal temperature condition for onions is mild climate around 21°C without any extreme heat or excessive rain. (Desalenge and Aklilu, 2003, p.5-7) It takes almost 2 months for the onion seeds to develop seedlings, roughly 2 months for the seedlings to develop visible bulbs and then an additional 2.5 months from the stage of visible bulbs to maturity of the onions. Farmers can cultivate seeds to seedlings at small farmlands and then transplant the seedlings to bigger farmlands for the ripening of onions, which need more space than the seedlings, and in that way only use the larger fields for about 4-4.5 months. It takes up to 12 months to produce new seeds since it takes 5-6 months for flower stalk development from onion bulbs. Onion fields should be rotated with other crops at least every fourth year to prevent soil borne diseases. (Desalenge and Aklilu, 2003, p.25) Improvements in soil nutrients (from compost, dung or inorganic fertilizers), water holding capability and texture can positively benefit the growth of onion bulbs. Examples of two inorganic fertilizers are DAP (Diammonium phosphate) and Urea. The amount of fertilizer needed is dependent on the soil type. (Desalenge and Aklilu, 2003, p.29)

Two common diseases of onions are purple spots and leaf mold. A fungus called *Alternaria porri* causes the purple blotches and the leaf mold is caused by the plant pathogen called *Peronospora destructor.* Thrips (*Thrips tabaci*) is a common pest to attack onions. Weeds can also be a problem since onions are poor competitors to weeds. Onions are especially vulnerable for weeds the first 6 weeks. (Desalenge and Aklilu, 2003, p.32). Onions are vulnerable to too much moisture and the risk for onions to be condemned by diseases increases in probability with humid weather conditions. There are various disease protections available to keep the onions from getting attacked by fungus or pests, for example Mancozeb, Karate, Selekron, Profit and Ridomil.

2.2.2 Onions cultivated in Ethiopia

Small farmers, private growers and some larger state enterprises in many parts of Ethiopia cultivate onions. Areas with good soil and weather conditions for the cultivation of onions are the Awash valley, Lake region and areas close to the Sudan border (Desalenge and Aklilu, 2003, p.8-9). In Ethiopia, the planted area for onions was 22,036 hectare (ha) in 2011, which corresponded to about 0.5 % of all onion-cultivated areas in the world. The production of onions in Ethiopia in 2011 was estimated to 236,922 tons, which was about 0.27% of all world onion production (FAOSTAT, 2013). The two cities Meki and Ziway are located in the fertile Lake region, this area is known as the onion belt of Ethiopia. Of the 46,600 inhabitants in Meki, 11,320 are farmers working with onion cultivation in an area of 5,650 ha. Of the 56,100 inhabitants in Ziway, 7,700 are farmers in an onion cultivation area of 11,500 ha (Citypopulation, 2013). The onion production is estimated to be 135,600 tons/year in Meki

and 34,766 tons/year in Ziway (Meki & Ziway agricultural office, 2014). The onion crops have contributed to Ethiopian economy by exports of bulbs and cut flowers (Desalenge and Aklilu, 2003, p.3). Onions can be produced throughout the year in Ethiopia due to the mild climate and the rainy season that provide water for irrigation.

The red onions (Figure 2) are culturally most accepted in Ethiopia. The emphasis of this research lies on the red onion since those are the most cultivated species in the vicinity of the city of Addis Ababa, where the research was conducted. Two big families of the red onion species are Adama Red and Bombay Red. Adama Red has the longest storage ability of the two. (Desalenge and Aklilu, 2003, p.15)

Figure 2 Red onions for sale in Addis Ababa.

2.3 LOGISTICS

One way to describe logistics is that it aims to map out flows in the corporate system in order to obtain a comprehensive view of the organization to improve the company's productivity. The most important thing is to satisfy the customers by providing as low prices as possible, with the highest service and to the best quality possible. The principal flows in question in an organization are physical matter, information and money. Logistics are not strictly bound to concern only flows in a corporation but can be a part of a bigger logistic system, i.e a supply chain. An example of a logistic network system is illustrated in Figure 3 as a logistic network divided into three stages with two intermediate points. (Gudehus and Kotzab, 2012, p 15-18). Another way of describing logistics is that the logistic activities serve to deliver goods in the most efficient way, in the **r**ight quantities at the **r**ight place, in the **r**ight order and at the **r**ight time. This is also known as the 4**r** of logistics (Gudehus and Kotzab, 2012, p 3).

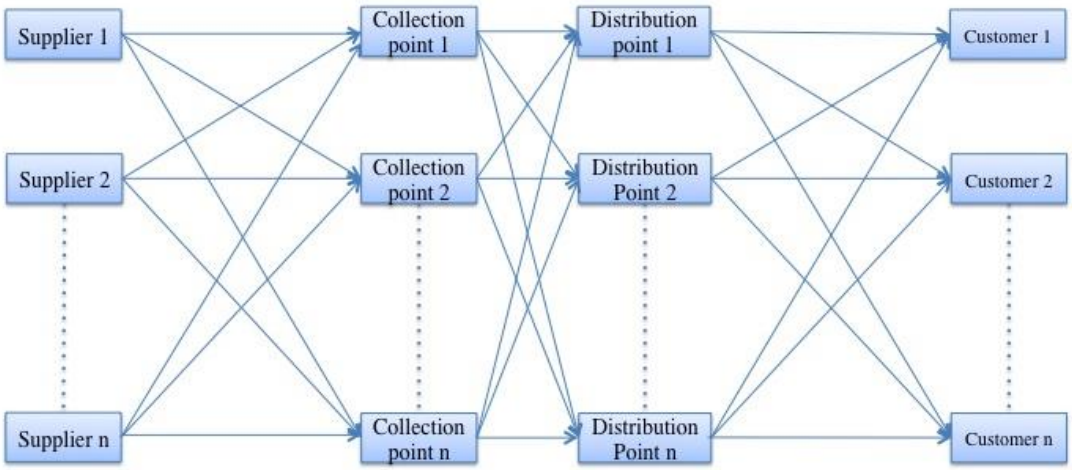

Figure 3: Three-stage network with collection and distribution points (Gudehus and Kotzab, 2012, p. 17):

A logistic network can contain many sources, sinks and intermediate nodes. Sinks are posts that bring the physical matter out of the chain, for example consumers. The intermediate nodes might be stores, logistic centers, transshipment zones, collection points or distribution points. There are some logistic networks that only consist of sources and sinks, in other words, no intermediate nodes are needed between the supplier and the consumer and the transport between them is unbroken. Other logistic systems contain subdivisions and the transportation between sources and sinks are broken one or more times at transitional points. Depending on the number of intermediate nodes with various operations, different levels of logistic networks exist as well as different solutions for the most efficient way to convey the transportation of goods.

2.3.1 Supply chain management

The definition of Supply Chain Management is relatively imprecise and there exist a handful of different definitions in various literatures. The consensus of all of them is that supply chain management organizes and controls integrated logistics systems from the suppliers to a distinct end user, to optimize the process. Recycling and the re-use of materials are part of the supply chain management. (Croom et al, 2000, p.69) (Choon Tan, 2000, p. 45). A integrated logistic system for a manufacturing company is illustrated in Figure 4. The thin arrows represent the information flow in the company whilst the thicker arrows at the bottom, represent the material flow. The thin arrows are only pointing in one direction but the information flow would optimally go in both directions to create a more integrated system built on feedback (Oskarsson et al, 2009, p.11-22).

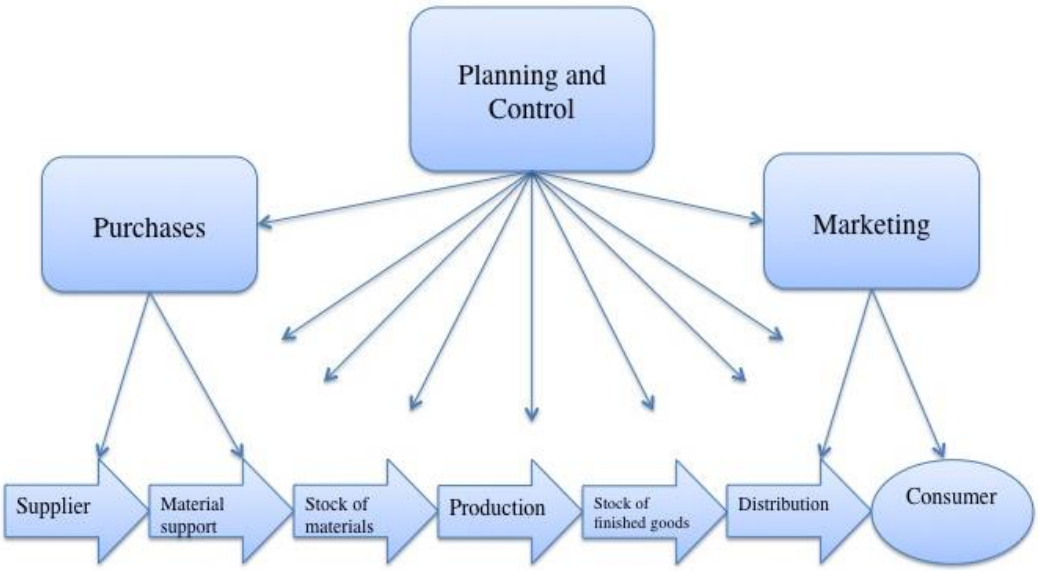

Figure 4: Simplified logistics system for a manufacturing company. Thin arrows represent the information flow (Oskarsson et al, 2009, p.22).

Supply chain management is also known as logistic network management, which further indicates that supply chain management deals with integrated systems in networks. The three fundamental stages in a logistic chain, procurement, production and distribution, was previously managed individually and independent of each other. That way of managing the supply chain resulted in large inventory and a slow response to customer demand (Thomas and Griffin, 1996, p.1). Supply chain management primary analyzes and organizes the procurement and distribution flows of a firm/corporation (da Silva and de Souza Filho, 2007, p.17), an example of procurement and distribution logistics for a plant or site is depicted in Figure 5.

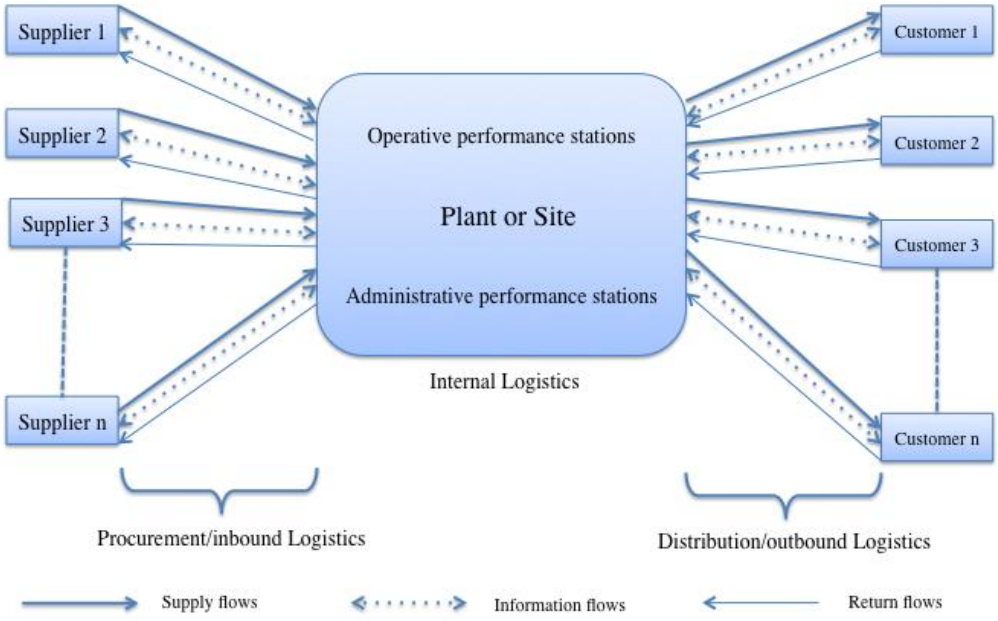

Figure 5 Areas of company logistics with procurement and distribution flows marked out (Gudehus and Kotzab, 2012, p.7).

2.3.2 Information flow

Alongside the materials in a supply chain, there is a flow of information (e.g. oral, data or documents) to control and trail the path of the supply flow. If the information is an order from a customer the information flow runs in the opposite direction of the supply flow. Order processes, information flow and data flow is necessary to secure a high quality of the logistic chain. Logistic supply strategies rely on effective information flow and thorough logistic data to work properly (Gudehus and Kotzab, 2012, p.760). The information flow supplies and drives the supply flow. A rapid and thorough exchange of information upstream and downstream the supply chain increases in importance when there is a requirement for a fast delivery. The customers' request for a certain device or service must reach the appropriate parts of the chain in good time for a chance to produce and deliver the object on time. One subsystem might need spare parts from another subsystem, which is why various subsystems also must have a functional information flow between them (Oskarsson et al, 2009, p.23 and 41).

2.3.3 Transportation

To symbolize transportation, straight arrow from one point to another is a commonly used method and this is often the way manufacturing companies sees the transportation flow as a straight and simple line. The transportation is though more complex from a transporters perspective, it includes combining goods from different companies, optimizing the routes based on available infrastructures and reloading of the trucks. To have a good transportation system a well-developed infrastructure is essential as is the need for good quality transports (Oskarsson et al, 2009, p.119-122). The transportation system is scrutinized based on the

usability, performance and cost from a logistics point of view. Transport systems are divided into either continuous or discontinuous. The continuous transport systems include for example gas pipelines and liquids and discontinuous transport systems include conveyor systems and vehicle systems. Conveyor systems are applied on indoor transportation and vehicle transportation can be either indoor or outdoor. What kind of transport system that suits a specific logistic system best depends on what kind of goods are to be transported and the distance of the transportation. (Gudehus and Kotzab, 2012, p 624-625).

2.3.4 Logistic terms

A logistic system consists, as mentioned before, of many sources, sinks and halfway stations that are linked together by transportations, movement of physical matters, money and information. The flows of supply and data that are going into a firm are called procurement logistics or inbound logistics and flows out of a company are called distribution logistics or outbound logistics. A logistic system can be divided into a hierarchy of subsystems with special tasks coined to each step. One way of grading a logistic network is presented by Gudehus and Kotzab, (2012, p 440):

1. Global logistics
2. National and regional logistic
3. Households, companies and service suppliers
4. Consumption, production and logistic sites
5. Handling, storing, commissioning, and vehicle systems
6. Machines and robots, which consist of parts, components or models.

While analyzing a logistic chain the strengths and weaknesses can be revealed and used to see where potential growth exists and where to put in extra support to create a more effective logistic chain. Systems that are undergoing rapid and dramatic changes might benefit fundamentally of a logistic chain analysis (da Silva and de Souza Filho, 2007, p.10). There are different ways in which actions and input affect the whole chain and thereby the quality of the end product. It is for example of importance to evaluate the properties of a system such as interdependency, propagation, feedback and synergy (da Silva and de Souza Filho, 2007, p.16).

- Interdependency means that all chain actors are intertwined with each other and the effectiveness of one actor will influence the effectiveness of the others.
- Propagation is the fact that since there is interdependency between the chain actors any impact somewhere in the chain will propagate upstream and downstream of the chain. Effects might be separated from the causes in a chain because of propagation.
- Feedback is when the chain actors adjust to changes due to propagation and a new round of propagation will arise because of these changes.
- Synergy means that the whole is greater than the sum of the parts, which is essential in logistics as the ambition is to create good prices and quality of the end product and to acquire satisfied end-customers.

2.4 VALUE CHAIN ANALYSIS

2.4.1 The value chain concept

To understand a company's competitive advantages it is necessary to look into all activities executed within the company, for example design, production, sales and service. If the events are analyzed, instead of the company as a whole, advantages can be gained in both cost efficiency and differentiation. To do this analysis Michael Porter introduced the value chain in 1985. His idea was to divide a business into its strategic activities to make them better than the rivals, or to a lower cost. A firm's value chain is affected by their suppliers' and customers' value chains since they are all parts of a value system. A supplier's value chain affects downstream (toward the consumer) in a value system. For example the quality of material that builds up the final product delivered to the consumer, if the raw material is of bad quality, it will have impacts downstream in the system all the way to the consumer. The challenge for the companies within a system is to see what the other parties' demand is and what they can supply, and from that make the best fit into the whole system. (Porter, 1985, p.33)

In all companies, nine general activities can be identified, which interact to achieve the goal together. These nine activities should all add value that exceeds the related cost. The company is profitable if the consumer find the value of the product to be higher than the total production cost. The difference between the value and the production cost is the company's margin. The value adding activities need human resources, material inputs and technology. The value activities are separated into two categories; Primary activities and support activities, which can be seen in Figure 6. The primary activities are connected to physical flow through the company, from inflow of material to outflow of a product. The primary activities are supported with human resources, purchased materials and other functions that are needed in a company, these are the support activities. How the value activities are carried out and to what cost decides how the company stands in a competitive market. (Porter, 1985, p.38)

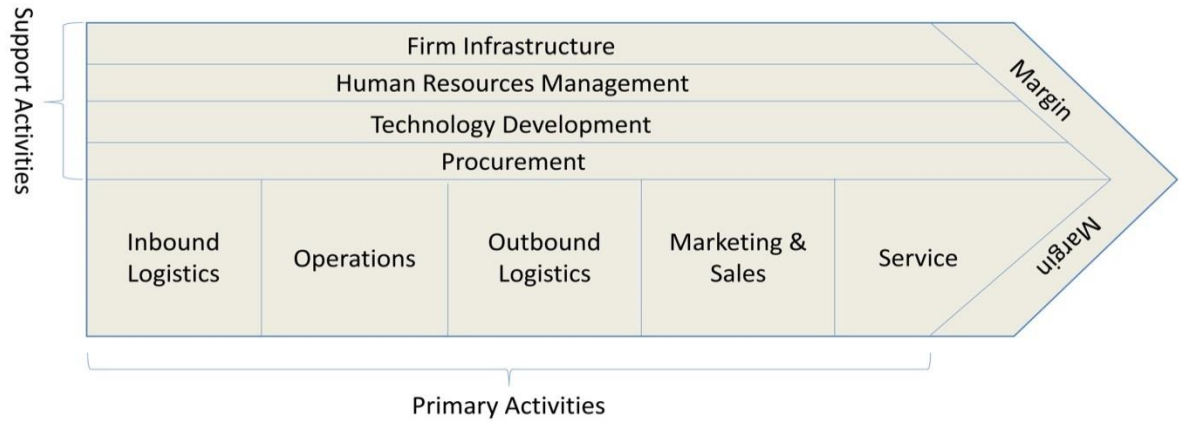

Figure 6: Porters model of the primary and support activities. (Porter, 1985, p. 37).

According to Porter (1985, p.39-43) there are five primary activities and four support activities as shown in Figure 6, these value activities are defined as followed:

Inbound logistics: All events connected to the inflow of materials before it is used in the production, for example transportation, warehousing and control of goods.

Operations: The activities where the inflow of materials are turned into a new product, which can be machining, assembling and testing.

Outbound logistics: When the operations stage is done, the final product is ready to be delivered to the customer. This activity can include storage of the products before they leave for the customers, taking care of orders and distribution of the products.

Sales and marketing: It is necessary to find and have contact with customers to sell the products. Activities in this category are for example advertising, pricing and sales.

Service: After the product has reached the customer it can be necessary to give service so that it keeps its functionality and value. Training and reparations are examples of activities in this category.

Firm infrastructure: This is where activities that build up a firm are done. Accounting, finance and planning are some of the important events within the firm infrastructure.

Human recourses management: Human resources are needed in all value activities. Recruiting, training and pay salary to the workers are examples within this support activity

Technology development: Technology of some kind is involved in all value activities. It might be more simple technology and know-how or advanced machinery used in the production. This is an activity that aims to improve all kinds of technologies to make the process or product better.

Procurement: This means purchasing of inputs needed in the company. The most obvious is raw material to the operations stage in the company, but all activities need purchased inputs, accounting tools required within the firm infrastructure stage is one example. This is an important activity since the cost for purchased inputs is a large post of a company's total cost.

All these value adding activities and the events within them have to be analyzed to define a firm's value chain. Large functions should be divided into smaller activities to better understand the costs and value added. For examples processing of raw material to the final product might hold a whole chain of steps where possibilities to improvements would not be seen if they were put together as one. When a value chain is defined, all activities and functions done by the company should be found and put into one of the primary or support activities category (Porter, 1985, p.45-48)

As described above, Porter used the term value chain for the activities performed within a firm while the term value system was defined as a network of companies interacting to produce and get a product to the market. However this terminology introduced by Porter can

be confused with latter work and definitions in the field where a value chain often describes the whole chain from producer to consumer (Kaplinsky & Morris, 2000, p.6-7). This text will hereafter use the latter definition of a value chain whilst the porter definition is used to analyze the individual actors in the chain.

2.4.2 Mapping a value chain

A value chain can be complex and contain a big number of actors. Each actor can also be connected to more than one value chain. Therefore it's important to know the aim of the study and the point of interest. Thereafter decision can be made on where in the chain to start and what to include in the chain analysis (Kaplinsky & Morris, 2000, p.50). The first step in a value chain study is to identify the actors and the connections between them to get the chain mapped out. This can be done with a qualitative study, followed by a quantitative study when the map of the chain is completed. The quantitative study gives more information about activities and relations in the chain and makes the study more certain (Hellin & Meijer, 2006).

When the value chain is mapped out it is time to investigate the chain in numbers; costs and the outgoing values in each step, from which the net output value can be calculated. Other interesting points to study in the chain are:

- Flow of material in the chain
- Employments, services and consultants used in the chain.
- Where the products end up after sales and how much to each customer.

To get a good picture of the value adding throughout the chain it is important to collect the data over time to see changes and trends in the chain. According to Kaplinsky & Morris, a five year period is recommended. (Kaplinsky & Morris, 2000, p.53)

Relations between actors in a chain can be affected by the governance within each step. The conditions might be set up by the most powerful actor in the value chain and the others have to adapt to the rules. The largest firm usually has the largest influence on the other actors in the chain. By doing a value chain analysis different indicators can be calculated to get a hint about which actor is the most powerful. One indicator is how big share each actor has from the total value added in the chain. Another indicator is how big share of the total profit in the chain each actor gets. (Kaplinsky & Morris, 2000, p.66)

2.5 ENVIRONMENT AND LOGISTICS

The logistic-approach primary tends to increase the efficiency of the supply chain to achieve the lowest possible cost, which go hand in hand with environmental issues most of the time. For example the optimization of transportation routes and the minimization of fuel consumption do gain both cost and environmental objectives. Besides optimizing the transportations, logisticians try to maximize the profits and contrive as much as possible out of the inbound materials, something that also gain a sustainable usage of assets. The environmental objects that do not comprise with the logistic objectives must be controlled by

governmental sanctions or legislative environmental initiatives. (Gudehus and Kotzab, 2012, p. 66 and 842).

2.5.1 Logistics applied to the supply chain of onions

An optimal supply chain (as mentioned earlier) is a system where the economy, physical flow and information all are integrated to the chain to optimize the process and induce a higher productivity throughout the chain. This would imply a close collaboration between the farmers, wholesalers, transporters and retailers when applied to the onion chain. For the economical point of view a strategy to create a good synergy must exist to make each actor realize that the whole is greater than the sum of the parts, something that can prove to be difficult. Each of the chain actors live on the income from that particular part of the chain and therefore may not see the possible gain in the future by changing something in the present, that might decrease the immediate income. The information and physical flow could both be handled from a head department or by one of the chain actors to control that the flows run as whished throughout the chain. This overhead department could tie the chain actors together to an integrated unity which is important to produce an effective and secure chain with planned harvests, pickups of onions and drop offs at the end stations. Besides the three traditional flows there is also a resource flow that determine the energy usage and environmental impact made by the chain activities. By keeping these in mind in the perspective, it may be possible to identify additional important improvements in the system that may not be seen otherwise.

2.6 USES OF ONION WASTES

Studies have been carried out to find different ways to make use for discarded onions. The residue onions can be used as food for animals, as compost and for biogas production. Cattle feed and compost are the traditional way of disposing of biological degradable residues.

Biogas is a mix of several different gases but primarily contains methane and carbon dioxide and is produced by anaerobic digestion. Anaerobic digestion is the process of which microorganisms' breakdown biodegradable material in the absence of oxygen (Al Seadi et al, 2008). In Ethiopia's rural areas, biogas can be used for cooking and lighting. In a German study on the potential for biogas in Ethiopia's farming districts, biogas is compared to the use of firewood and dung as energy source. Benefits of using biogas would be that the slurry can be used as fertilizer and another benefit is that the labor for collection of firewood and dung can be reduced. Farmers with livestock were investigated in the study to see if it would be profitable to invest in a biogas plant. Households that bought firewood and built a bigger biogas plant had a better return from the investment. (Gwavuya et.al, 2012)

An onion company in California, USA, has invested $9.5-million to turn onion wastes into energy. All onion peels, tails and tops from the production are grinded to produce a juice that gives biogas through anaerobic digestion. The onion production gives 100 tons of wastes per day, which give about 3 normal cubic meters biogas with a methane content of 70 % every minute. The biogas is purified to get a high content of methane that can be used to power two 300 kW fuel cells. The company has an electrical base load of 600 kW, which is powered

from the fuel cells. 80 % of the fuel comes from the biogas production whilst natural gas is used when there is a shortage in biogas. (Josse et.al, 2010)

2.6.1 Alternative usages of onion wastes

Useless onions have also proven to be successfully used in the production of onion vinegar with a two-step fermentation system at research level (Horiuchi et al, 2003). It is also possible to produce alcohol for beverages from the onion juice from rejected onions by adding a form of yeast to the juice that decomposes the sugars in the juice into Ethanol. (Horiuchi et al, 2000). Onions can be processed into onion oil and powder to be used as flavor in cooking (Shigyo and Kik, 2008, p.121).

3. METHODOLOGY

The literature review presented in Chapter 2 was used as background and structure for how the analyses were conducted. The logistic chain was investigated in two main parts: the physical and the economical flow. The information chain is reviewed as part of the physical supply flow in order to find out if the onion losses can be reduced by a more efficient flow of information and if the information chain of today has any flaws. The value chain was studied to see where and how much value is added throughout the chain and to find out the economic cost of the losses in each stage.

3.1 DATA COLLECTION METHODS

The selected method to gather data was interviews. An interview involves a conversation with a person whom has the required information. A personal meeting provides the best conditions for obtaining the thoughts of the interviewed person compared to only sending out questionnaires. The contact can also be important in explaining the issues, so that the interviewee understands the questions properly and the interviewer may also ask supplementary questions. An important advantage of interviews is that they can overcome the language barriers by the aid of translators. There are two basic types of interviews; open or controlled. An open interview has more of a conversation character while controlled interviews are based on a list of questions and has more of a question-answer character. Open interviews are focused on what the interviewee thinks is important while controlled interviews are designed to get more precise answers. (Kylén, 2004, p.9)

For the purpose of the study, controlled interviews were chosen. The same questions had to be asked to all interviewees within each stage of the chain to get comparable answers. This method was chosen despite the fact that there might be some uncertainty concerning the answers since direct contact with the chain actors although seemed to be the most reliable approach to gain information in this study. The interviewees might give answers that they think satisfies what the interviewers are after instead of answering truthfully. If there are unclear or questionable answers the interviewee can be contacted again by telephone for follow up questions. In case of need of follow up questions but no contact can be made after

the first interview the interview can be removed completely to ensure correct answers. All the steps from planning to delivered products were mapped out by interviews with workers at the different stages of the chain. All people in Ethiopia do not speak English since the national language is Amharic. A translator was needed in the interviews to overcome language barriers. All questionnaires are attached in Appendix A-J.

The aim with each interview with the chain actors was as follows:

- *Farmer:* The farmer is the first step in the chain and all parameters that affect the onion production was investigated. The different activities from plowing to harvesting were looked into to see how much cost the different stages caused for the value chain analysis. It was also important to examine how the farmers get information about the market price for onions, what kind and how much fertilizers and disease protection to use and prices for those and the usage of onion wastes. How the farmer finds brokers and workers was also of importance. To represent the area of Meki/Ziway six farmers were interviewed, based on the fact that the landscape, climate and over all economics are reasonably the same throughout the areas.
- *Broker:* The broker is an information provider in the chain, mainly between farmers in Meki/Ziway and wholesalers in Addis Ababa. The broker also checks the quality of the onions and supervises the harvest. The information flow between farmer and wholesaler through the broker will be investigated, as will the added value in this step. Three interviews were conducted at this stage due to the fact that the broker is not a very important part of the chain from a logistic point of view since there is no supply flow through the broker.
- *Transporter:* The transporter carries out transportation of onions from the farmers in Meki/Ziway into Addis Ababa. There were two interviews carried out at this stage due to the fact that there is no certain location to find transporters to interview. They usually get to the market in the middle of the night. This step was studied to see how the onions are transported to Addis Ababa and if there are any losses related to this activity.
- *Wholesaler:* Nine wholesalers were interviewed, all located at the fruit and vegetable market, Atkilt Tera. The wholesalers either owns a truck themselves for the transportation of onions or contacts a transport company to rent trucks and drivers from. The onion losses at the wholesalers' shops were looked into. Purchase and selling prices was found out to see how value is added to the onions.
- *Retailer:* Seven Retailers located in Addis Ababa were interviewed. The retailers buy onions from the wholesalers and sell them to the end consumers. Different kinds of retailers such as supermarkets, stands at fruit markets and sellers on the street were part of the study. How and for how long they store their onions was investigated as well as the purchase and selling prices to see how value is added to the onions. The amount of losses at market-level, why they occur and if the losses are used for anything or just thrown away were of interest to find out.

- *Consumer:* Restaurants in Addis Ababa represent the consumers of this research. Nine restaurants have participated in the research. Where the restaurants buy their onions and why they have chosen that particular place has been found out. How they store their onions and for how long were also looked into. If they have any feedback system for when they receive onions of bad quality, the onion losses and the reasons why the onions go bad were studied.

4. RESULTS

4.1 SUPPLY CHAIN FOR ONIONS IN ETHIOPIA

The supply chain of onions from the agricultural areas of Meki and Ziway to the consumers in the capital of Ethiopia, Addis Ababa, has been investigated by interviews. The main chain actors were found to be farmers, brokers, transporters, wholesalers, retailers and consumers. The way the chain actors are related to each other is illustrated in Figure 7. There are basically two chains, one that goes directly to the consumers from the wholesalers and one that go through wholesalers to retailers and then finally to the consumers, this is also indicated in Figure 7. Six farmers in the Meki and Ziway area, two transporters, three brokers, nine wholesalers in Addis Ababa, seven retailers in Addis Ababa and nine consumers (restaurants) in Addis Ababa have participated in the research by answering the questions the interviews were based on is attached in Appendix A,C,E,G,I and J. The following subchapters will include more detailed results from the interviews within each chain actor block where all the information is coming from the people that have participated in the interviews.

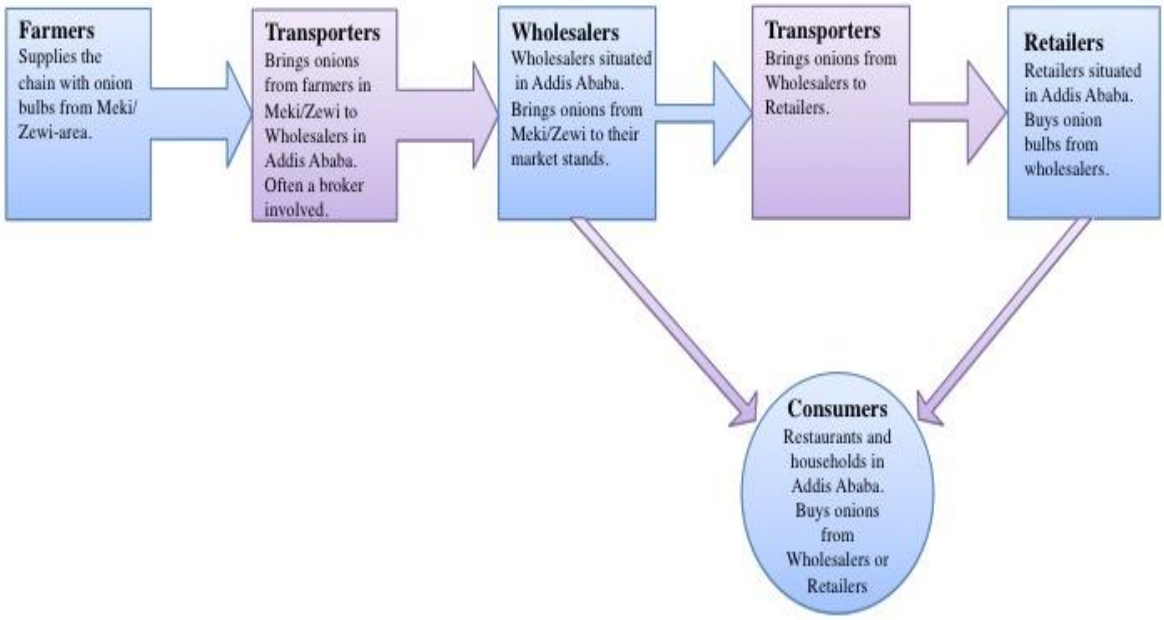

Figure 7: An illustration of the different stages of the chain. Purple color indicates transportation.

Another way to illustrate the onion food chain is shown in Figure 8 which aims at illustrating how and what kind of information that flows through the chain. The supply chain of onions in Ethiopia goes under the subsystem called National and Regional Logistics and downwards in the classification of logistic systems hierarchy mentioned in chapter 2.3.1. The subsystem at the bottom of the logistic hierarchy pyramid, number 6: machines and robots, which consist of parts, components or models, is not applicable to the agricultural supply chain of this research.

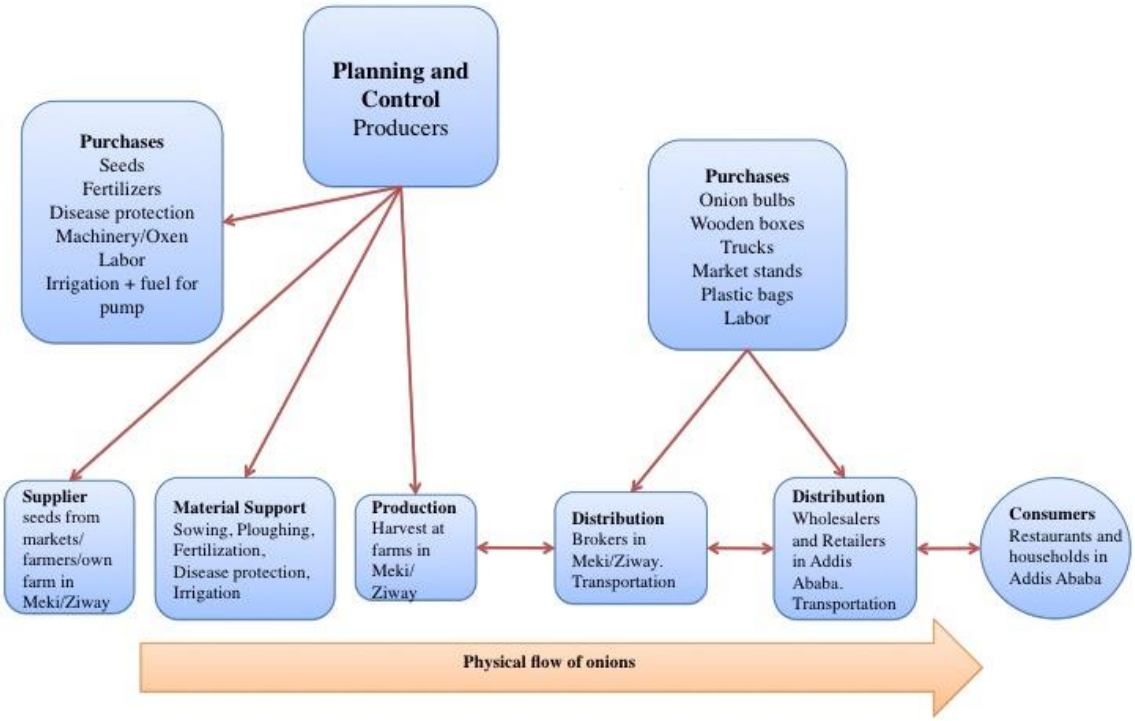

Figure 8: An example of how the information chain looks for onions between Meki/Zewi and Addis Ababa in Ethiopia. Red arrows represent information flow.

4.1.1 Farmer

Six farmers have been interviewed in Meki and Ziway and those six farmers are assumed to be representable for the whole Meki/Ziway area. Each interview has been thorough and it was decided that since the landscape, the weather conditions and the overall economy is reasonably the same for all farmers in the area six interviewees where enough to cover the farmers block of the logistic chain. The results from the questionnaires with the farmers will be represented with graphs and/or with an average response when possible. An onion field in Ethiopia is depicted in Figure 9 below.

Figure 9 Onion field outside of Meki, Ethiopia.

Land use

The farmers in the area has an average of just under 1 ha of land each and half of the farmers own the land themselves, the rest rents the land from another farmer or owns parts of the land and rents parts of the land, see Figure 10.

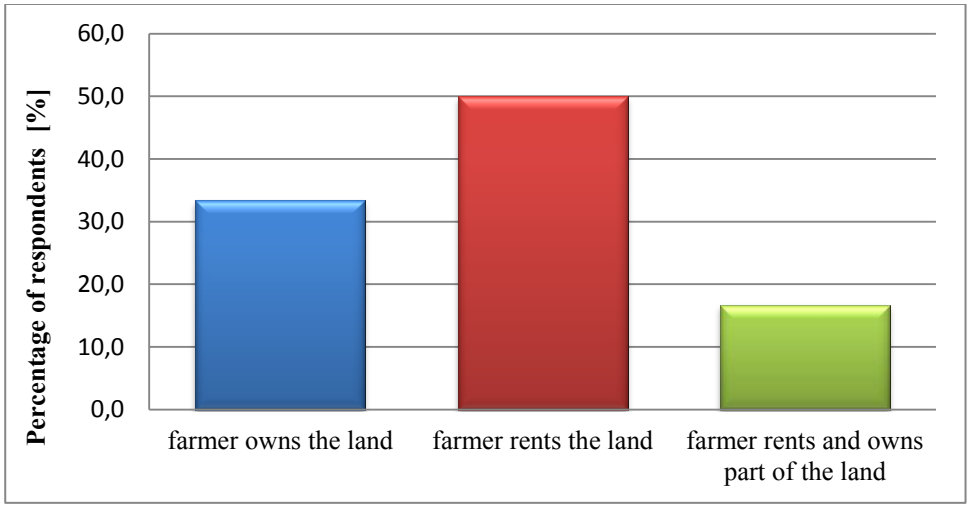

Figure 10: The percentages of respondents that owns the land, rents the land or does both.

The amount of harvest episodes varies between two and four per year and half of the farmers rotate the fields with tomatoes, wheat or pepper. The sowing-harvest process is continuous all

through the year independent of season for all the farmers in the area and half of the farmers state that the quality of the onions goes down during the rainy season while two out of six farmers claim that the quality is unaffected by the season, see Figure 11.

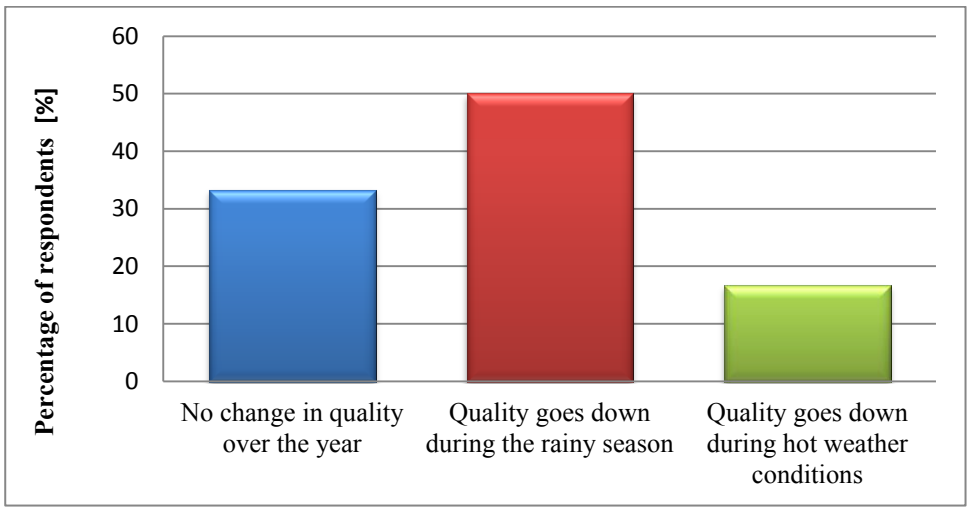

Figure 11: How onion quality changes over the year.

The onion species Bombay Red is especially popular for cultivation in this area, the species Adama Red is also used but more rarely. Bombay Red is chosen mostly based on the quality of the bulbs and because of the relatively short growing period. The yield from the different farms varies between 16,000 kg/ha and 27,000kg/ha with a mean value of 20,400kg/ha for all the participating farmers. All the interviewed farmers sell onions to Addis Ababa, but they do not sell all their onions to Addis Ababa but also to other cities and regions, see Figure 12 and Figure 13 where the amount of onions that are sold to a certain area is depicted. The largest proportion of all interviewed farmers onion harvest is although sold to Addis Ababa and only smaller amounts go to the other areas.

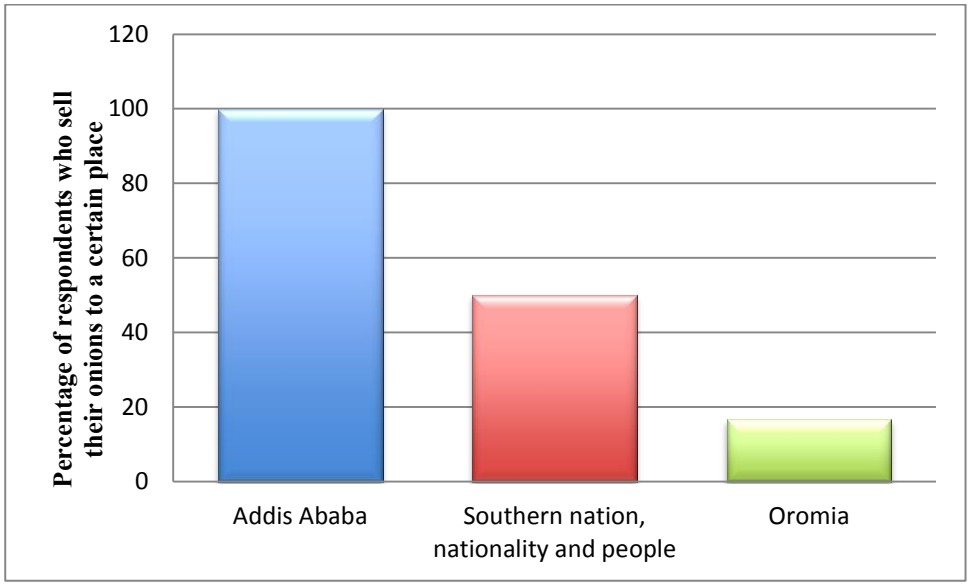

Figure 12: Regions in Ethiopia where the farmers sell their onions.

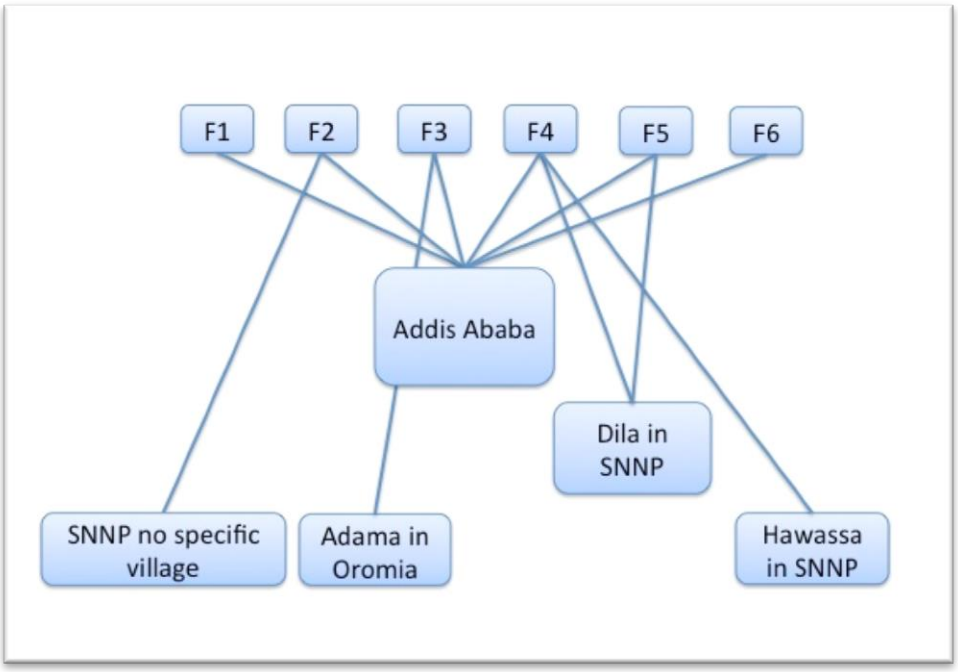

Figure 13: Relations of what areas the farmers sell their onions to. F1-F6 stands for Farmer 1, Farmer 2 etc.

Sowing

The reason to why the farmers choose to buy a particular seed/seedling is mainly the quality of the fully-grown onions but two of the six respondents state that they just buy what seeds/seedlings are available in the area independent of quality.

Treatments

All the farmers use DAP and Urea as fertilizers and applies the fertilizers at an early stage when plowing the fields. All farmers use a various set of disease protection such as Mancozeb, Karate, Selekron, Ridomil, Profit, Fungozeb and Helerat. They all use more than one disease protection, see Figure 14. Selekron is the one disease protection that all farmers use in combination with other pesticides.

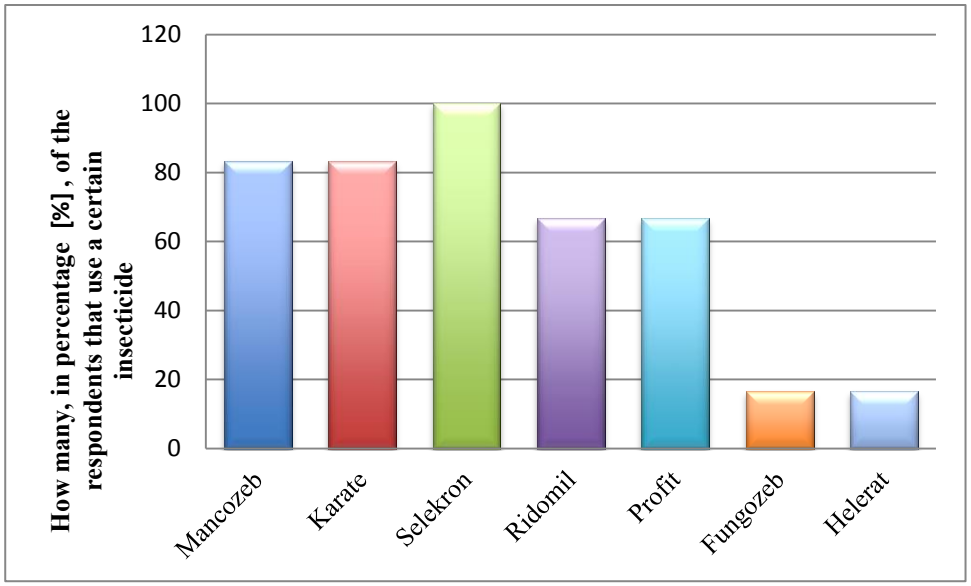

Figure 14: Disease protections the farmers use.

All the farmers in the area state that disease protection is essential, the crop would be totally destroyed if no pesticides where used. Two of the respondents say that there are no negative consequences by using disease protection, one says that too much disease protection might harm the crop by burning it in the sun, two claim that skin protection for the workers is necessary when using Karate or Helerat and one says that the workers who use pesticides must mind what they eat because they might lose weight as a result of inhaling the fumes from the pesticides. All the farmers in the area use irrigation from pumps installed at the fields. The plowing of the fields is either conducted by oxen or by tractor and oxen at different stages of the cultivation.

Harvest

All farmers use wooden boxes to put the onions in at harvesting. The wooden boxes are owned or rented by the brokers and the wooden boxes can be reused many times.

Post-harvest

All farmers state that the onions are poured onto the truck from the wooden boxes they were picked in, where they lie freely during the transportation from the farm. All farmers also say that there is no storage possibilities for the onions at the farm, all onions are sold at once when they are picked from the soil. The onions are transported on ISUZU-trucks brought by the wholesalers from the farmers. The farmers are not involved in choosing transport companies, this is organized by either wholesalers or brokers.

Losses

Three of the farmers claim to have no actual onion losses, they reduce the price of the bad onions and sell it all. One farmer says that he has 5 % losses of the yield and that he leaves the losses on the ground to decompose. Another farmer has 1% losses that he just throws away. The actual losses at farmer level is depicted in figure 15 and the amount of lower priced

onions due to bad quality is shown in figure 16. The mean amount of actual losses at farmer level is thus 1.7%.

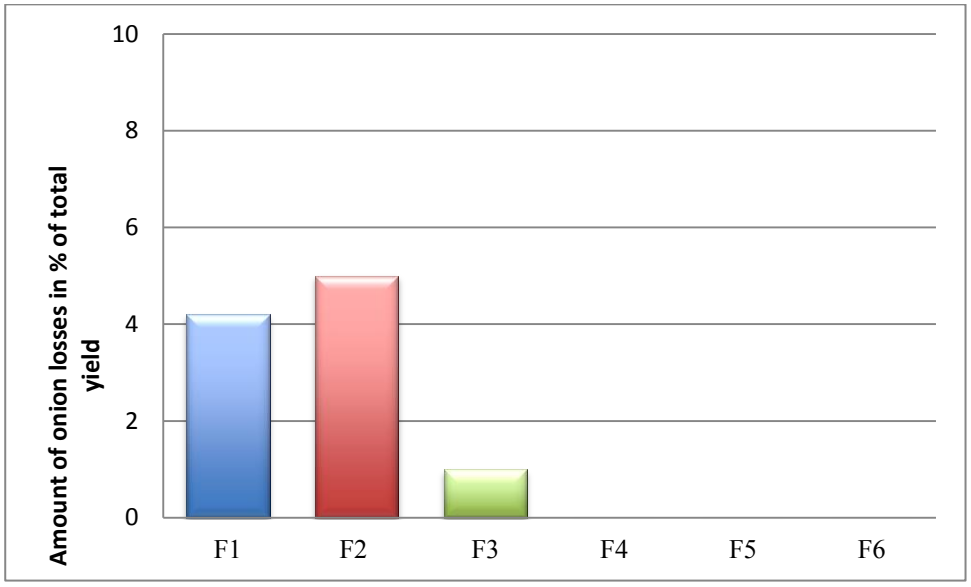

Figure 15: The amount of onion losses in [%] at farmer level. F1-F6 stands for farmer 1 to farmer 6.

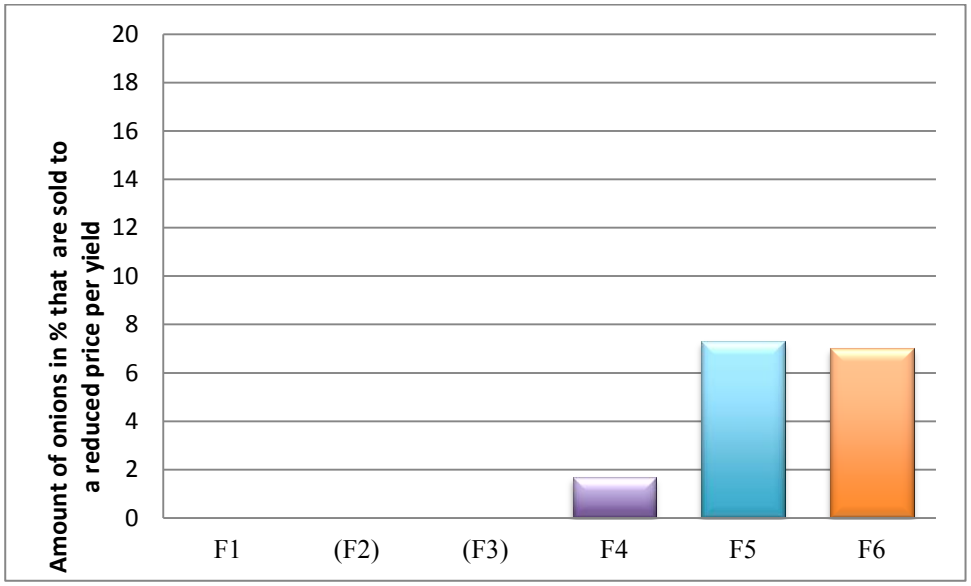

Figure 16: The amount of onions in % sold to a reduced price at farmer level. F1-F6 stands for farmer 1 to farmer 6.

To the question of who makes the decisions about if the onions should be thrown away/sold to a reduced price half of farmers answered that it is the wholesaler that makes those decisions, as indicated in Figure 17.

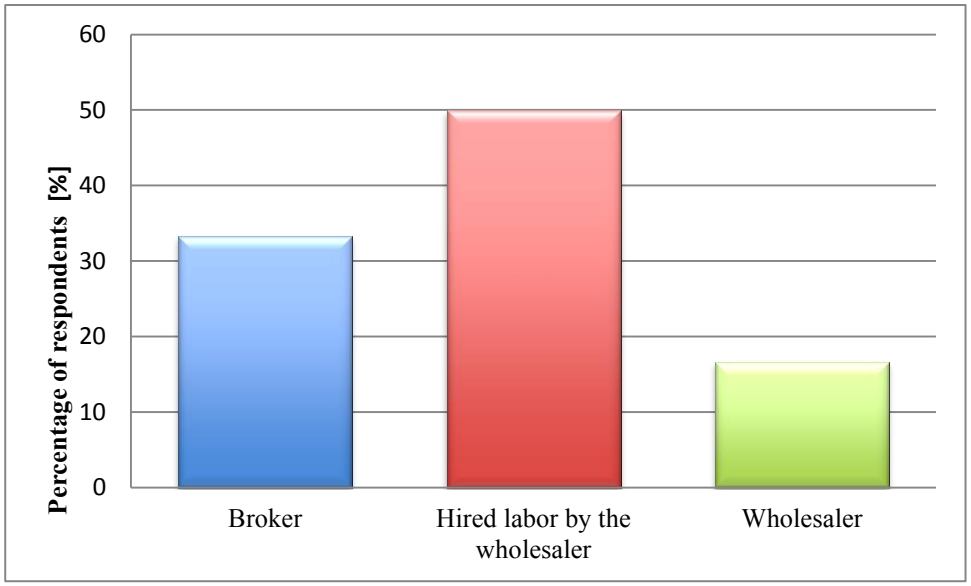

Figure 17: Whom it is that makes the decisions about if the onions are to be thrown away/sold to a reduced price

Information

Most of the farmers get their information about possible buyers from brokers, one of the respondents state that they in addition to brokers he finds buyers from previous businesses. None of the farmers pays for the broker that is used to connect the farmer with potential buyers, it is the wholesalers who pays the brokers. The most common way for farmers to get in contact with the brokers is that they call each other, who calls whom depends on the market situation but one of the six respondents state that they get in contact with brokers via the local market. Half of the respondents find out about what prices to charge for their onions through brokers, two of them gets the information from other farmers or acquaintances and one of them finds out via the local market. All farmers say that different buyers pay different prices for the onions based on negotiation. Most of the farmers find workers for the fieldwork in the local village at cafés where workers usually hang out and one farmer state that he finds labor via acquaintances. How the farmers find out what prices that are reasonable for fertilizers and disease protection and where they buy the treatments is shown in Figure 18.

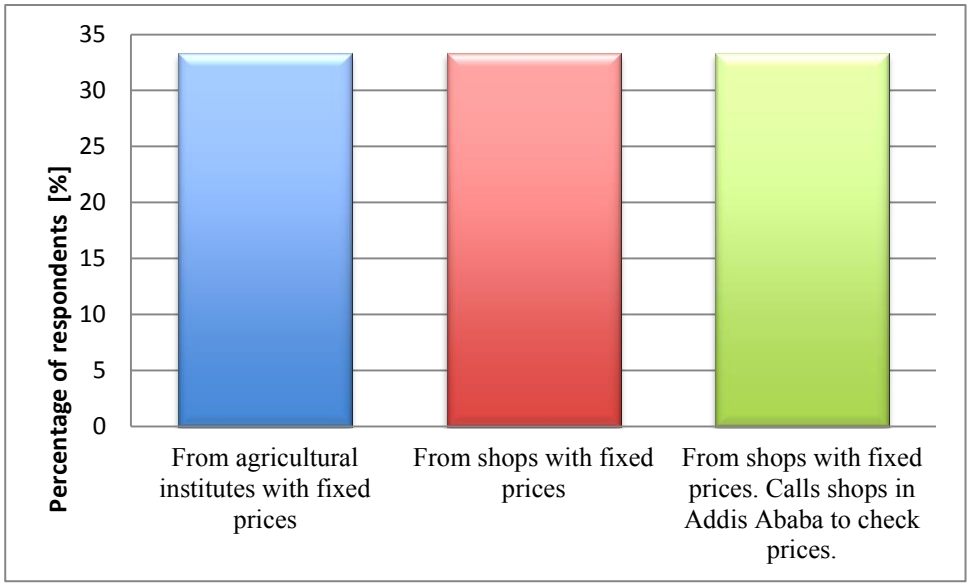

Figure 18: How the farmers find out about prices for treatments and where they buy the treatments.

The demand pattern for onions is random all through the year according to five of the six interviewed farmers and the remaining one says that the demand pattern is seasonal. All farmers say that they know how much onions to sow based on experience. How the cooperation between the farmers look is depicted in Figure 19.

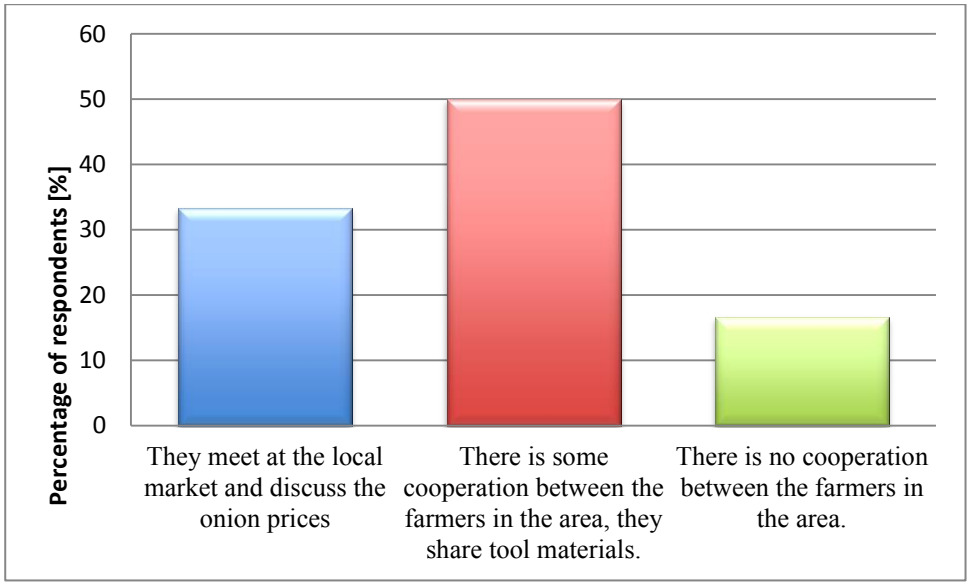

Figure 19: Cooperation possibilities between the farmers according to the interviews.

4.1.2 Broker

The broker connects farmers with wholesalers and vice versa, checks the quality and supervises the harvesting. It was decided that three interviews was enough at this stage due to the fact that the broker is not a very important part of the chain from a logistic point of view, there is no supply flow through the broker. The results from the interviews with the brokers will be represented with graphs and/or with an average response when possible.

General

Over 50% of the brokers' commissions are onions but they all also work with other fruits and vegetables. All the brokers are located out in the rural areas close to the farmers. One of the interviewed brokers is part of a broker-group organized by the government. All the brokers visit the farms in advance to check the quality of the onions before contacting potential buyers. One of the brokers says that the workload goes up from February until November, another one says that the workload is randomly distributed over the year but peaks at holidays and the third says that it is the rainy season that provides most job since Ziway is one of the few places in Ethiopia that can produce onions during this time.

Information

One of the brokers states that he finds farmers to deal with in a local café where farmers and brokers hang out. The other two brokers keep contact with farmers via telephone where the contact goes both ways. Two of the brokers chooses which farmers to deal with primarily based on personal relations but says that the quality of the farmers' onions is also important. The last broker says that he chooses farmers mainly based on the quality of the farmers' onions. All three brokers emphasizes that they can work with the same farmer for more than one time but it is not very common to do so. The brokers' relationships to farmers versus wholesalers are illustrated in Figure 20, implying that one broker knows many farmers but only a few wholesalers. This is accurate for all three interviewed brokers.

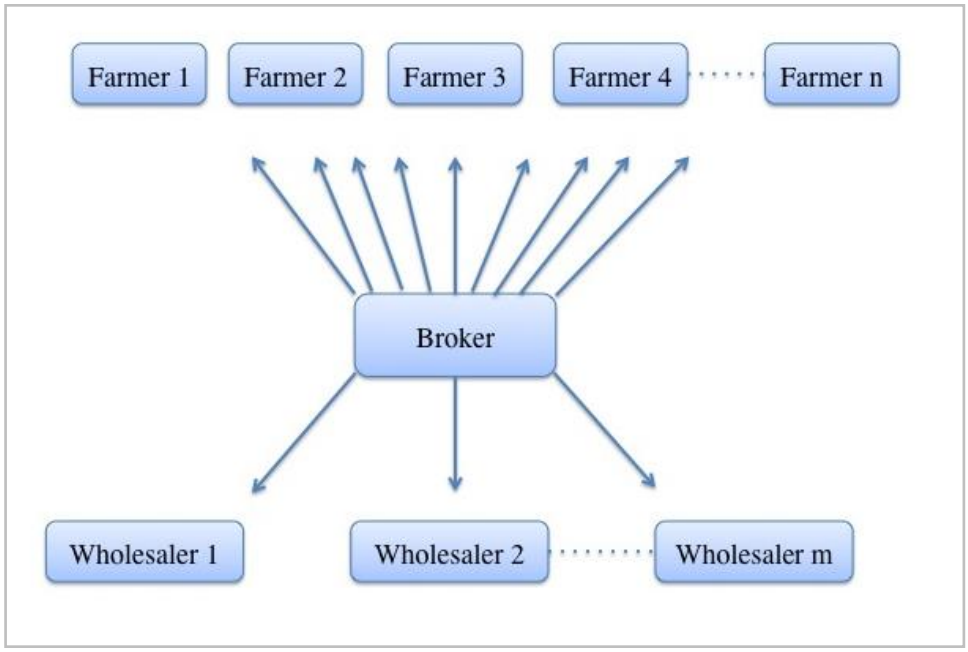

Figure 20: Illustration of the brokers relations to farmers and wholesalers.

Two of the three brokers claim that the wholesalers are the ones contacting them while the last broker says that the contact goes both ways. The contacts are established via telephone. 2/3 of the brokers do not work with the same wholesaler for more than one time but the last broker always works with the same wholesalers. One of the brokers says that the wholesalers are the ones choosing him and the other two says that they have some freedom to choose

between wholesalers, which ones they want to work with. They choose the friendliest ones but the amount they are paid is also crucial. All brokers state that they do not arrange the transportations of the onions, it is the wholesalers who do that. All three brokers arrange with the wooden boxes to pick the onions into during harvest. They choose the wooden boxes based on price and quality: environmentally friendliness is not a factor that they are concerned with. On the question whether the broker can leave any feedback to the farmers if the quality of the onions are bad the answers are confusing, the idea of feedback seem to be something strange to the brokers. However, the answer they give is that the bad onions are just left on the farm and not paid for.

4.1.3 Transporter

The transporters interviewed in this research include only transports of onions from Meki/Ziway to Addis Ababa. An ISUZO-truck is shown loaded with onions in Figure 21.

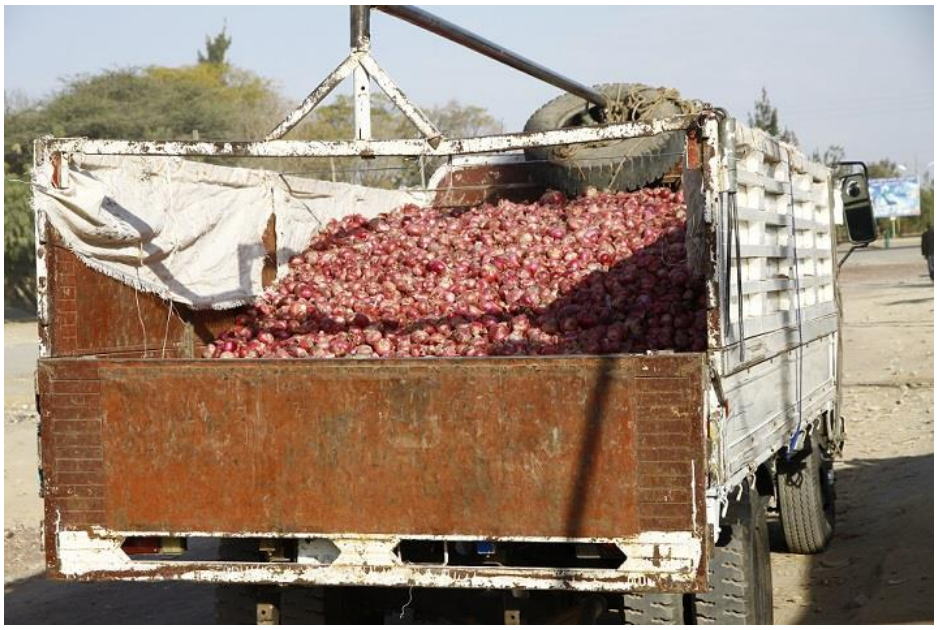

Figure 21 ISUZO-truck loaded with onions in Ziway, Ethiopia.

General

The transport companies in this study are both small with just one truck. The two transport companies in this research consist of one driver, one service helper and the owner of the truck. The first transporter owns an ISUZU truck that can carry up to 5000 kg, even if it is registered from maximum of 3000kg. They have added higher walls to the truck to be able to carry more goods. The second transporter has an ISUZU truck that can carry up to a 6000 kg load. The workload over the year is randomly distributed for one of the transporters whereas the other one states that there is almost no work at all during the rainy season.

Transports

The time for the 160 km transports from Ziway to Addis Ababa is between three and four hours and both transport companies conduct their transporting during the evening to avoid

traffic jams. The whole load of onions end up in the fruit and vegetable market Atikilt Tera at Piazza in Addis Ababa. There are usually no problems with the traffic in Addis Ababa since they arrive in late evening but if there is a traffic jam the transportation time is increased by in average one hour, state both transporters. None of the transport companies' trucks have emission control systems such as catalysts or particle filters. An ISUZU truck consumes about 0.5 liter per km, which means that the total gas requirement for the trip Ziway – Addis Ababa is about 80 liter. There is no problem to keep the onions fresh during the transportation according to both transporters. The transportation takes place during the evening when the sun is set and if it is not raining the top of the truck is left open so fresh air reaches the onions. The only potential problem is if it is raining heavily and moist gets through the tarpaulin to the onions. There are no problems with onions falling off the truck and/or onions getting damaged by the pressure of other onions.

Losses

Onion losses during the transportation are perceived so rare that none of the interviewees can give a number of how much loss there might be. If there ever would be any losses then the driver is responsible since he is paid to bring the onions to Addis Ababa at the same state at as they were in when they left Ziway. Any lost onion would be given to oxen and cows to eat according to the first transporter and the second one says that they would just throw the bad onions away if there were any.

Information

It is usually the wholesaler who contacts the transporter via brokers to establish a business deal. One of the transporters has two steady wholesalers that he always works for but he is matched up with other wholesalers as well by brokers. The other transporter does only work for random wholesalers. Brokers also establish the transporters contact with farmers. It is up to the wholesaler to decide if some onions are in a too bad state at arrival to Addis Ababa and has to be thrown away says both transporters. The future plan for one of the transporters is to get a bigger truck and the second one does not know what plans there are for the future.

4.1.4 Wholesaler

Nine wholesalers have been interviewed at the fruit and vegetable market Atikilt Tera at Piazza in Addis Ababa to represent the wholesalers in this study. The wholesalers buy the onions directly from the farmers and some of the wholesalers carry out the transportation of the onions themselves and other wholesalers hire trucks and drivers.

General

The wholesalers primarily sell onions from the Meki / Ziway district but two of the nine respondents state that they also get onions from other districts further away from Addis Ababa close to the Sudan border. Figure 22 show if the wholesalers ever purchase too much or too little amount of onions.

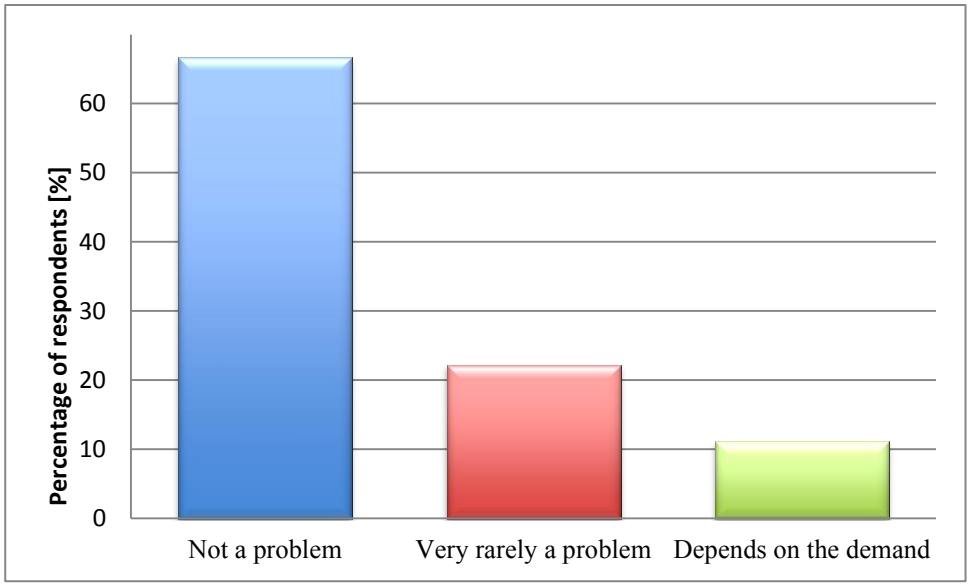

Figure 22: Wholesalers response to the question of whether it is ever a problem of purchasing too much or too little amounts of onions.

All the interviewed wholesalers get to see samples of the onions in advance except for one who says that he trust the broker who has seen the quality of the onions before buying them. Seven of the nine respondents to the questionnaire have storage possibilities for onions at their stands and the time for storage varies between one day and one week depending on the quality of the onions. All the wholesalers say that they have all kind of customers: restaurants, retailers and households. How the proportions to the different customer groups are divided is illustrated in Figure 23.

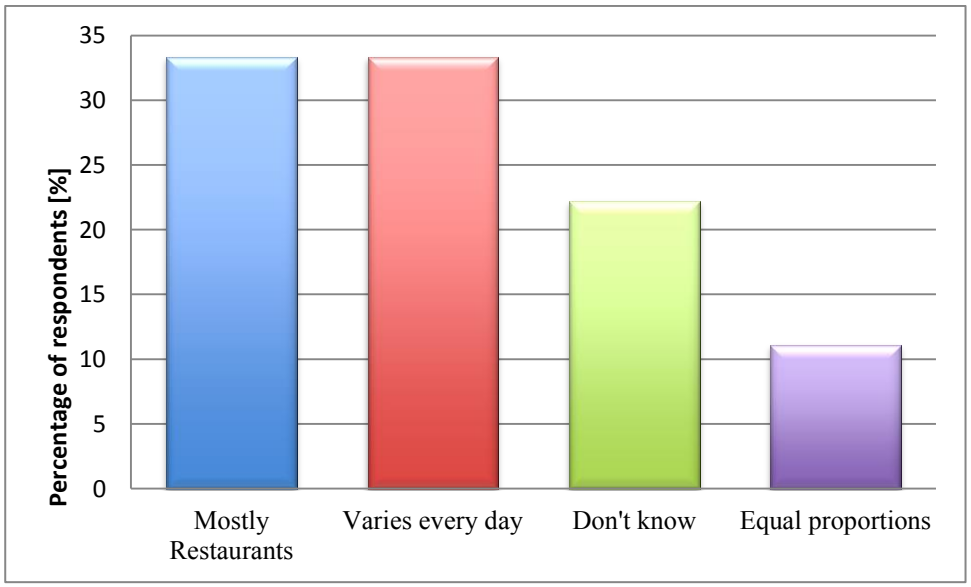

Figure 23: Wholesalers response to the question: How much is sold to each type of costumer

Four of the wholesalers say that the workload is randomly distributed over the year, three say that the workload is random over the year but peaks at holidays and two of them finds the workload consistent over the year with peaks at holidays and fasting times.

Transports

All wholesalers use Isuzu-trucks that can carry between 4800 kg and 7000kg but it is most common with trucks that carries 6000kg of load. Two of the wholesalers own their own truck whereas the rest hire transport companies. The time for transportation between Meki /Ziway to Addis Ababa varies between three hours up to six hours according to the wholesalers. Over half of the wholesalers answers that the whole load from one truck ends up in Piazza and that it is only onions on the truck. Two of the interviewed wholesalers say that the truck also drops off onions and other vegetables to other markets in Addis Ababa like Mercato and Saris. There is no problem with the traffic situation in Addis Ababa according to almost all of the wholesalers but two of them say that there are problems with traffic jams. There is no refrigeration of onions on the trucks; the onions lie freely on the trunk and the transportations are carried out during the cold and dark night. If it is raining the onions are covered by plastic covers. Most of the wholesalers say that it is not a problem to keep the onions fresh during transportation but three of the nine respondents state that rain is a problem during the wet season and moist might get through the plastic covers and damage the onions. There are basically no losses reported by the interviewed wholesalers during transportation. There might occur some losses during transportation if the truck has to stop for maintenance because of a car accident but that is very rare adds two of the wholesalers. One wholesaler mentions that it has happened in the past that the whole truck overturned due to bad roads and the whole load of onions was lost. Five of the wholesalers say that it is the wholesaler who is economically responsible if there would be any losses during transportation, the rest say that the price will be negotiated if the quality is bad.

Losses at the market

The wholesalers must sometimes reduce the price to charge for the onions if the quality is less than expected. The amount of losses at the market for each wholesaler is shown in Figure 24. All the wholesalers say that the onion wastes are just thrown in the garbage or left on the ground for sweepers to clean up except one of the wholesalers who says that the onions wastes are given to goats and other animals to eat. Most of the losses are dry peel that either falls off the onion or are removed by hand see an example from the backyard of a wholesalers stand in Figure 25. The mean value for losses at the market for the wholesalers is 2.3 %.

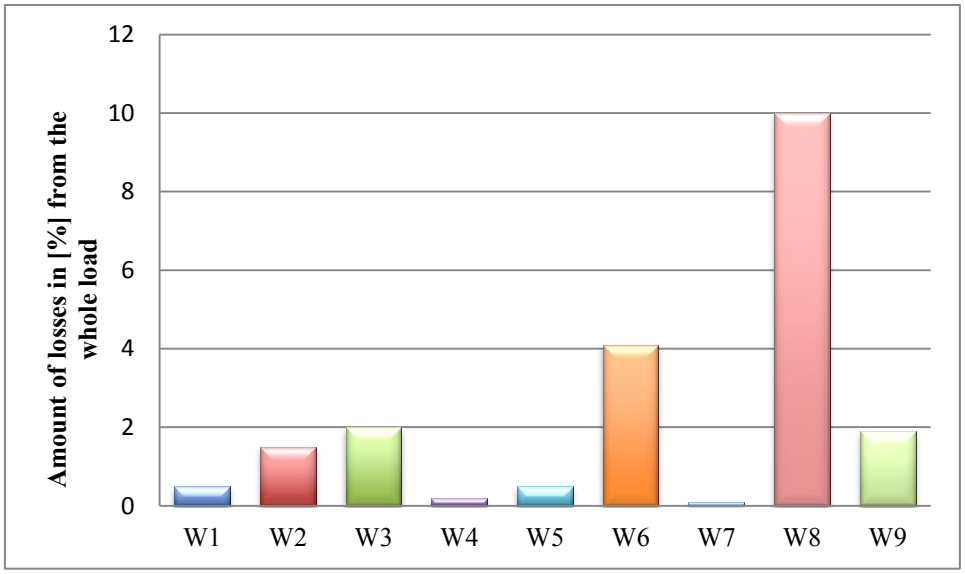

Figure 24: The amount of onion losses in [%] at market level for the wholesalers. W1-W9 stands for wholesaler 1 to wholesaler 9.

Figure 25 Dry peels lying on the ground behind a wholesaler stand in Addis Ababa.

Information

The wholesalers who do not own their own truck usually use a broker to get in contact with transporters but one of the wholesalers claim that the drivers will get in contact with the wholesaler and not the other way round. The wholesalers deal with different farmers and a varying numbers of farmers depending on the season. Two of the nine interviewed wholesalers say that they do have some fixed farmers that they always buy onions from when those farmers are harvesting. Whether or not the wholesalers have direct contact with the farmers is depicted in Figure 26.

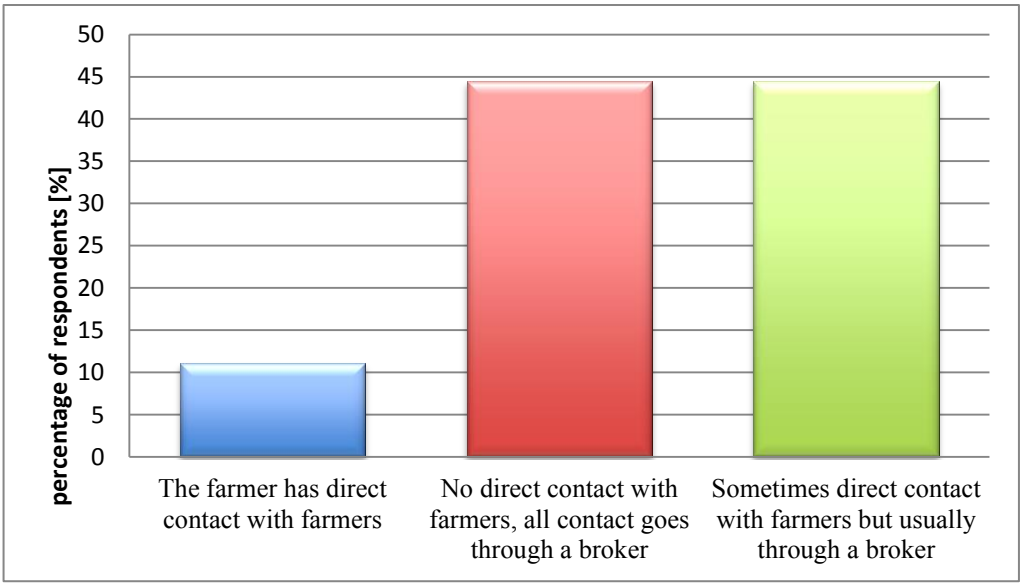

Figure 26: Contact with farmers

More than half of the wholesalers state that it is the wholesaler who makes the decisions on whether or not to throw the onions away. One wholesaler say that it is labor hired by the wholesaler that decides and two of the interviewees do not know who it is up to decide if the onions are to be thrown away or not. Six of the nine wholesalers have a both way communication with the brokers. Who contacts whom is depending on the market situation, if there is a great need of onions the wholesalers contact the broker and the broker will contact the wholesalers if the wholesaler hasn't taken contact with the broker in a while when the demand of onions is low. Most of the wholesalers do not follow up on the quality if the delivered onions are bad, only one of the wholesalers call the farmer and ask if they have better onions for sale. All interviewed wholesalers make plans for new onion purchases one day in advance except for one that makes the plans two days in advance.

4.1.5 Retailer

Seven interviews at different levels of retailers participated in the study, such as supermarkets, stands at fruit markets and sellers on the streets, to catch appropriate representatives for the different logistic chains of the onions. The reason why certain onion species are bought and where the retailers buy their onions was looked into as how they store their onions and for how long. The amount of losses at market-level for retailers, why they occur and also if the losses are used for anything or just thrown away will be presented in this chapter.

General

The retailers that have contributed are located in the districts Shiromeda, Bole, Arat Kilo and Kebena, see figure 27. The two retailers in Shiromeda are small fruit and vegetable stands, the three retailers in Bole are supermarkets, the one in Arat Kilo is a small fruit and vegetable stand and the one in Kebena is a restaurant that both uses vegetables for their own cooking and sell vegetables outside the restaurant. All retailers state that they inspect samples of the onions before buying them, four out of the seven retailers go by themselves to the market and

will thus see the onions before buying them, one of the retailers only states that he/she will se samples in advance and two retailers have purchasers who checks the quality of the onions before bringing the onions to the store. The most common customers to all the retailers are private households. Four retailers also say that in addition to householders it is also sometimes restaurants that buy onions. Four out of the seven retailers do not have any special place for storage of onions, one of them keeps the onions on a shelf in room temperature and two of them store their onions in dry rooms without refrigeration. The onions are never kept in storage for a long time since the demand for onions is high in Addis Ababa, maximum storage time is one week.

Transportation

All retailers buy their onions from the fruit and vegetable market Atikilt Tera at Piazza. It is 5 km of transportation from Shiromeda, 7 km from Bole, 3 km from Arat Kilo and 4 km from Kebena, see Figure 27.

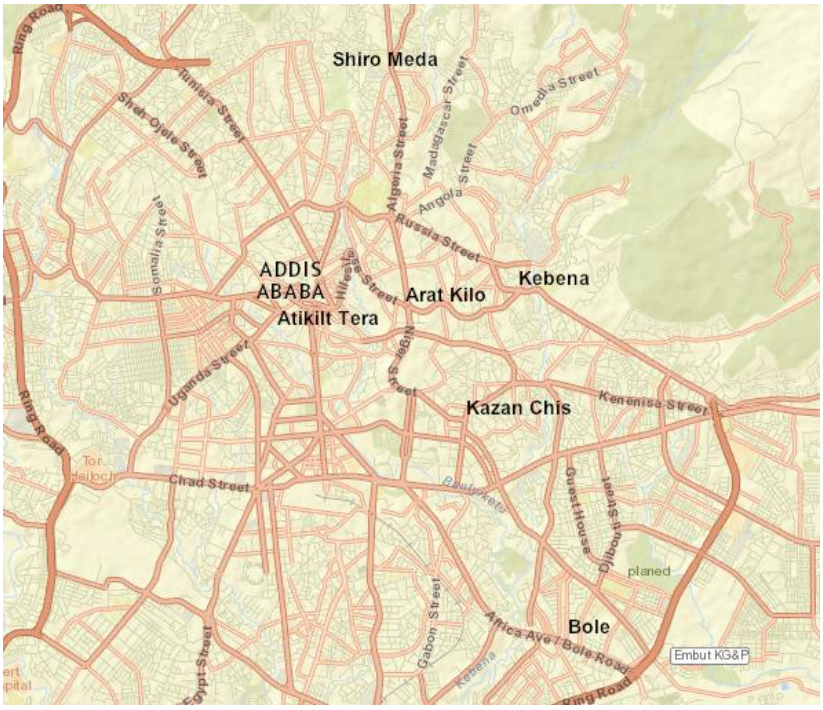

Figure 27: Map of Addis Ababa. Retailers 1 and 2 are situated in Shiromeda, Retailers 3 to 5 are in Bole, retailer 6 in Arat Kilo and retailer 7 in Kebena. The fruit market Atikilt Tera is also denoted in the figure.

Atkilt Tera. Both retailers in Shiromeda go by public transportation to the market in Atikilt Tera; they use the mini buses between Piazza and Shiromeda. One of them goes three times a week and the other one goes once a week. Two of the supermarkets in Bole have shop owned cars that they do all their vegetable purchases with. One of the retailers from Bole goes to Atikilt Tera three times a week, one goes two times a week and the last one goes once a week. The retailer in Arat Kilo purchases onions twice a week and travels by the public service mini-buses and the retailer in Kebena goes once a week also by mini-buses. Six of the seven retailers do their onion purchases in the morning and the last one goes in the afternoon. Three out of seven retailers answered that they do not experience any problems with traffic jams,

two say that it always is traffic jams and the last two say that it might be traffic jams sometimes. None of the retailers have any losses of onions during transportation; it is only fictional losses due to different scaling.

Losses

The estimated losses at the retailers stands/shops is shown in Figure 28. Onions getting wet and old is the most common reason for onions to go bad at retailer level. One retailer also points out that the pressure of all the other onions might damage the onions at the bottom of the onion pile. Nothing special is done with the onion losses, they are thrown away in the garbage. Two of the supermarkets in Bole say that they write down how much onions are thrown away to keep track of their losses. The mean value of losses at market level for the retailers is 4.7%.

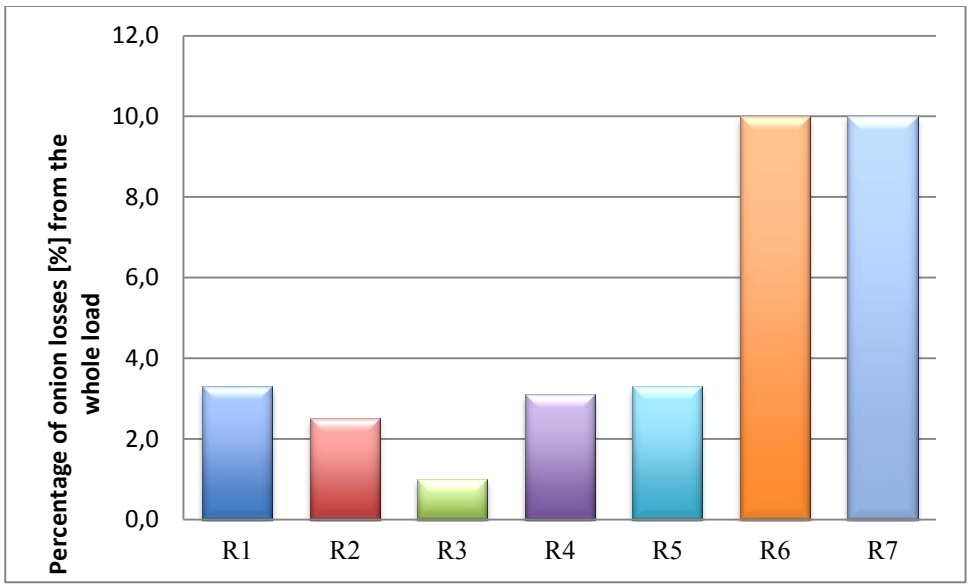

Figure 28: The amount of onion losses in [%] at market level for the retailers. R1-R7 stands for retailer 1 to retailer 7.

Information

All retailers state that they do not buy their onions from the same wholesaler every time they purchase onions. They choose the wholesaler based on who has the best quality to the best price at the time for purchase. All retailers say that it is the owner of the store/stand that decides if onions are too bad to be sold. None of the retailers have contact with brokers. There is no follow up system if the qualities of the onions are bad for any of the retailers.

4.1.6 Consumer

Nine interviews have been made in the consumer-level. Where the restaurants buy their onions and why they have chosen that particular place will be presented, how they store their onions and for how long and if they have any feedback system for when they receive onions of bad quality. In addition to this, onion losses and reason why the onions go bad will be presented in this chapter.

General

The restaurants that have contributed are located in Shiromeda, Bole, Arat Kilo, Kebena and Kazan chis, the locations are marked in the map in Figure 27. All participating restaurants state that they buy their onions from the fruit and vegetable market Atikilt Tera at Piazza. They buy their onions there because they can also find all other fruits and vegetables that the restaurant requires, good quality to fair prices. All restaurants keep their onions in dry storage rooms in room temperature together with other fruits and vegetables except for one restaurant that do not have a special storage of onions or any other vegetables.

Transportation

The restaurant in Shiromeda purchases their onions from Atikilt Tera at Piazza, it is 5 km of transportation and they go twice a week. The three restaurants in Bole buy their onions from Piazza, which is a 7 km trip, and they purchase onions twice, three times and four times a week respectively. One of the restaurants in Arat Kilo gets the onions delivered once a week from a wholesaler. The remaining two restaurants in Arat Kilo buy their onions from Piazza, which is a 3 km trip, and they once a week respectively every day of the week. The restaurant in Kebena purchases their onions from Piazza two times a week and the distance to Piazza is 4 km. The restaurant in Kazan Chis also buys their onions from Piazza, they go once a week and the distance to Piazza is 5 km. Four of the restaurants use cars owned by the company to purchase onions and the remaining five interviewees say that the wholesalers brings the onions to the restaurants in cars owned by the wholesaler. Seven of the restaurant owners state that there are no onion losses during transportation. The other two restaurant owners say that there might be some minimal losses if moist get through to the onions.

Losses

The most common reason for onions to go bad is according to five of the restaurants that the onions get wet and are exposed to humid weather conditions. Two of the restaurants say that the reason for throwing away onions is bad quality and if the onions get old. The amount of onion losses at consumer level is depicted in Figure 29.

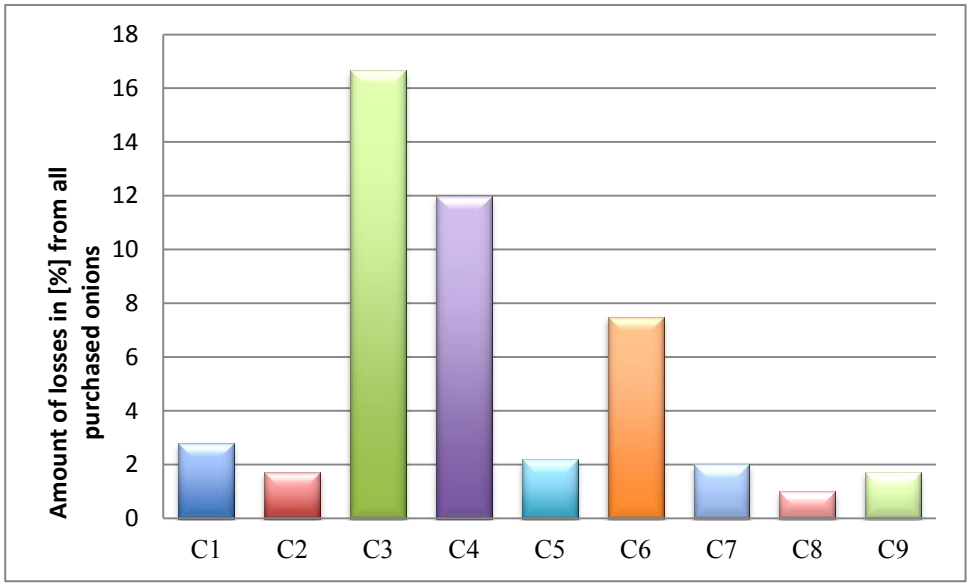

Figure 29: The amount of onion losses in [%] at the restaurants. C1-C9 stands for consumer 1 to consumer 9.

The seven restaurants with onion losses all say that the wastes are thrown in the garbage bin. The remaining two restaurants do not have any onion losses. The summarized value of onion losses at restaurant level is 5.3 %.

Information

Five of the consumers say that it is up to the head chef at the restaurant to decide if the onions should be thrown away. Three say that it is the owner of the restaurant that makes the decisions about if the quality is good enough to be used and one did not answer the question. On the question whether there is any follow-up system on the quality of the onions to the sellers did five of the consumers state that they will tell the wholesaler who brings the onions to the restaurant if they don't like the quality and the wholesaler will replace the bad ones. Four of the nine restaurants say that they let the sellers know if they are not satisfied with the quality by not purchasing onions from that place again.

4.1.6 Summary of supply chain

The summarized onion losses in percentage at each supply chain level are depicted below in Table 1. The first column gives the summarized losses for each chain actor level. The second column tells how much of the total losses each chain actor level stands for. At the bottom of the table is the summarized onion loss for the whole chain.

Table 1 Summarized losses per chain actor and the total losses each chain actor level stands for.

	Summarized losses per chain level [%]	Percentage of total chain losses [%]
Farmer	1.7	13
Broker	0	0
Transporter	0	0
Wholesaler	2.3	17
Retailer	4.7	34
Consumer	5.3	36
The whole chain	13.3	100

The alternative chain, when the end consumer purchases their onions directly from the Wholesalers and the Retailers do not participate have the summarized losses as depicted below in Table 2.

Table 2 Table of summarized losses per chain actor and the total losses each chain actor level stands for in the alternative chain without retailers.

	Summarized losses per chain level [%]	Percentage of total chain losses [%]
Farmer	1.7	19
Broker	0	0
Transporter	0	0
Wholesaler	2.3	25
Consumer	5.3	56
The whole chain	9.05	100

4.2 ENERGY EXTRACTION FROM ONION WASTES

From the example studied in the literature review, approximation can be done on how much energy the onion wastes in the agricultural area of Meki and Ziway can give. The onion production is as mentioned estimated to be 135,600 tons/year in Meki and 34,766 tons/year in Ziway, which gives a total of 170,366 tons per year. The calculated losses at farmer level are according to the study 1.7 % and if this is applied to the total onion production the calculated onion losses will be roughly 3000 tons per year. With the same biogas yield as in the literature review it would give about 130,000 normal cubic meters of biogas. Biogas stoves can be used for cooking and requires 220 liters of biogas for one hour of use (ENEA consulting, 2013). Each farmer could use a biogas stove for about 30 hours per year with the fuel produced from onion wastes.

If the biogas is used in fuel cells, it would generate about 350 MWh electricity per year (0.115 kWh/kg of onions). The total electricity consumption in Meki and Ziway can be calculated from the population in the area and the electricity consumption in Ethiopia which gives an

annual amount of 6,162 MWh. Biogas from onion wastes can thus account for 5.7% of the electricity consumption in Meki and Ziway. The cost of electricity in Ethiopia was 0.57 ETB/kWh in 2014 (Climateinvestmentfunds, 2014). Hence the value of the electricity produced by biogas from onion wastes is about 200,000 ETB per year, which gives 10.5 ETB per farmer and year if the profit would be divided between all the onion farmers in the area.

4.3. VALUE CHAIN ANALYSIS

All actors in the studied chain are small businesses with only a few employees, it can therefore be difficult to categorize activities and find their costs. All activities within the businesses are often done by one or just a few persons. The relevance of Porter's activities in this study will be discussed more later on, but the Marketing & Sales activity can already at this stage be reduced to only Sales since no actor in the chain uses marketing. Service is another value adding activity that might not be applicable in this chain. The studied product is a fresh vegetable and there is no service to do on the product itself. Throughout the chain, customer service could only be found when restaurants were not satisfied with the quality, some wholesalers then replaced the bad onions. The costs in each step of the chain have been identified to get the total cost per produced kg of onions to go from farmer to consumer. Only the amount of onions that go to the next step in the chain has been used in the calculations to get the total cost for usable onions. Information from the interviews has been used to find an average actor in each step. All costs are represented in Ethiopian Birr (ETB). 1 USD ~ 20 ETB.

4.3.1 Farmer

The farmer-step is the first and most complex stage in the value chain. The costs for the different activities varied widely between the six interviewed farmers. The size of the onion fields are from 0.44 up to 1.25 Hectares. Costs at the farms have been investigated to get a total production cost per kg of onions. Not all farmers could answer all questions. In the case where costs for activities could not be given by one or more farmers, other farmers' answers have been used as an approximation instead of leaving the cost for the activity as a zero-answer. Basic data such as land size and yield can be found in Table 3.

Table 3: Land size, yield, losses and the amount of onions sold to a reduced price for the six farmers.

	F1	F2	F3	F4	F5	F6
Size of land (Hectare)	0.44	0.75	0.60	1.25	1	0.63
Yield (kg)	12000	18000	10000	21000	22000	10000
Losses (kg)	500	900	100	0	0	0
Onions sold to reduced price (kg)	0	0	0	200	1600	600

Inbound logistics

The products needed for growing onions are mainly seeds, disease protection and fertilizers. All products are purchased in agricultural stores in small villages nearby. Seeds can also be bought from neighbor farmers that have their own seed production. The farmers say that the transportation of the products never is a problem. Disease protections and seeds are bought in

small quantities, up to 20 kg. The usage of fertilizers is heavier, from 500 kg up to over 1000 kg. The transportation is made by the small three-wheel motorcycle called Bajaj or by donkey- and horse carriage. The distance for the transports is a few kilometers and cost typically 10 ETB per 100 kg of goods. The cost for inbound logistics is small compared to other activities; the average cost is 0.01 ETB/kg produced onions.

Operations

The operations are the farming activities from plowing to harvesting. Except the small cost for the inbound logistics, all identified costs are found in this category. The costs have been put into the different farming activities with separated labor and material costs. The activities are: plowing, sowing, fertilization, irrigation, disease protection, weed picking and harvest. Also the cost for land use has been taken into account. The costs are presented in Table 4 and Table 5 in ETB/kg onions.

Table 4: Cost for each activity, presented in Ethiopian Birr/kg onions.

Operations (ETB/kg)	F1	F2	F3	F4	F5	F6	Average
Plowing	0.12	0.13	0.11	0.04	0.15	0.23	0.13
sowing	0.24	0.31	0.39	0.20	0.18	0.24	0.26
Fertilization	1.30	0.74	0.57	0.38	0.54	0.80	0.72
Irrigation	0.40	0.44	0.71	0.46	0.43	0.50	0.49
Disease protection	0.82	0.64	0.57	0.39	0.80	0.54	0.63
Land use	0.00	0.23	0.20	0.11	0.30	0.00	0.14
Operations Total	2.88	2.48	2.54	1.59	2.40	2.32	**2.37**

Plowing is carried out with a tractor and/or oxen. The tractor is rented from an owner in the area and is paid per hectare plowed land. Tractor is only used in the first plowing, oxen are then used to make the last preparations before sowing/planting. Two of the farmers used only oxen for the whole plowing process. Oxen are either rented or owned by the farmer. For farmer number 6, the plowing cost includes workers since oxen and workers were rented as one. Farmer number 4 has the lowest plowing cost; he only uses his own oxen. The oxen feed from the nature so there is no cost for owning the oxen. Farmer number 2 pays 2000 ETB per year to a shepherd to look after the oxen when they are not used.

The amount of seeds used varies from 16 up to 22.5 kg/ha. The farmers answered that the price for the seeds depends on the season and the market. Farmers paid from 200 ETB/kg up to 350 ETB/kg. Farmer number 3 had seed production on a field next to the onion field. The cost for the seeds was then calculated from the lost income when using the seeds instead of selling them.

The usage of DAP and Urea as fertilizers is in the same magnitude for farmer 2-6, 200-667 kg/hectare. Farmer 1 uses 1356 kg per hectare and also gets the highest yield per hectare. In a follow-up interview the farmer changed the answer and stated that only about 1/13 of his first answer was used. The farmer's first answer was used in the calculations since he got the

highest yield and was the one who was best paid for the onions, which might be an indicator that more fertilizers are used. DAP and Urea cost 12-16 ETB/kg.

All farmers use water pumps to get water from wells to the fields for the irrigation. A pump cost from 10-15,000 ETB and has a lifetime of 3-12 years. Irrigation is done every fourth day or once in a week. 10-20 liters of fuel, petrol or diesel, are used each time. The average use of fuel for irrigation per kg produced onions is 0.03 liter.

The onion fields are sprayed with pesticides to get protection against pests and plant diseases. Totally nine different pesticides were used at the six farms. Which pesticides and the amount used differs from farm to farm. Also the prices vary; one farmer can pay twice as much as another farmer pays for the same pesticide.

The land used for onion production is either rented or owned. Even though the references in the literature study stated that the government owns all land in Ethiopia, three farmers answered that the land they used was their own. In that case they only paid a small amount in tax to the government every year. The price for buying the land could not be answered; the land can be inherited or bought a long time ago so that the price is not known. When the land is rented from the landowner, it costs 8,000-16,000 ETB per hectare and year. The seeds are put in the soil in a smaller land where they are left to grow for two months. The grown seedlings are then put out in the big land to grow to onions for three months. Two of the farmers let the soil rest after harvest before new onions are grown; they say that it is necessary in order to keep the quality of the soil. When the soil is left to rest after harvest, they get 2.4 harvests per year. One farmer maximized the production and got up to 4 harvests per year. The other three farmers had 3 harvests per year.

Onions of lower quality can either be sold to a reduced price or used for other purposes that are not income generating. The lower quality is often due to moisture-damage and cannot be avoided since it is weather related. Three of the six farmers sell the lower quality onions to a reduced price and the other three use them as animal food or plow them down in the soil. The total production cost for the useable onions would have been 0.06 ETB/kg lower if there were no losses at the farms. Including onions of bad quality that have to be sold to a reduced price gives 0.11 ETB/kg.

Table 5: Labor cost for each activity in ETB/kg onions.

Operations Labor (ETB/kg)	F1	F2	F3	F4	F5	F6	Average
Plowing	0.03	0.07	0.04	0.03	0.05	0.00	0.03
Sowing/planting	0.05	0.06	0.05	0.04	0.23	0.05	0.08
Fertilization	0.05	0.05	0.11	0.04	0.11	0.27	0.10
Irrigation	0.28	0.05	0.00	0.04	0.11	0.27	0.12
Weed picking	0.52	0.58	0.61	0.42	0.52	0.60	0.54
Disease protection	0.10	0.05	0.05	0.04	0.11	0.27	0.10
Harvest & packing	0.29	0.31	0.26	0.34	0.35	0.32	0.31
Labor Total	1.33	1.18	1.11	0.94	1.46	1.77	**1.30**

Operations labor

The labor costs for the different farming activities are shown in Table 5. The farmer often has one or two permanent employees to do the more regular work and hires temporary workers to do the other jobs. A temporary worker is typically paid 60-80 ETB for one day of work whilst a permanent worker's salary is 700-800 ETB monthly. Most of the workers are men but women can help at harvest or to do the weed picking. The more regular work is irrigation, fertilization and disease protection. Temporary workers can get paid per day or for the work they have finished. A group of workers can also get paid together to complete a particular job. Workers that do the planting and weed picking can get paid in either of the above mentioned ways. For the harvest workers, it is the same at all farms. About 20 temporary workers are hired per 0.25 hectare. 10 workers do the harvesting and get 60-100 ETB each. The other 10 cut the green top off and make the onions ready for transportation, they get 10 ETB per box containing 50 kg of onions. Figure 30 shows a man working on the onion field.

Figure 30: A worker is preparing the land before planting the seedlings.

Outbound logistics

The onions are bought and transported away from the farm directly at harvest. The wholesaler or the broker is the one responsible to find a truck and a driver for the transportation. When the onions are harvested they are picked in wooden boxes and weighted before they are put on the truck. The work done to prepare the onions for transport from the farm counts as the harvest step and the cost is found in the Operations stage.

Sales

When a farmer has a product to sell, a broker is contacted to find buyers. There are many brokers in the area and all of the interviewed farmers used one to get buyers for their onions. The broker comes to the farm to do a quality check and give a price to the farmer. Some of the farmers contact people in Addis Ababa to get an idea of the price level so that they can negotiate with the broker. When they agree, the farmer's job with the sales ends. The broker contacts wholesaler to tell them that he has onions to sell. The cost for this activity would be the working time spent on finding and negotiating with a broker and also the phone costs to be able to have contact with brokers. Since it is the farmer himself doing the job, no direct costs for salary could be found in this activity. The price for mobile phone service is 0.83 ETB/minute (Ethio Telecom, n.d). Considering the price for telecommunication, costs for making phone calls or in other ways contact the brokers can be assumed to be considerable small compared to activities under the Operations stage. The selling price for the onions is in the range from 4.0 ETB up to 5.8 ETB per kg. The prices are seasonal and this is the price farmers got at their latest harvest at the time for the interviews in November and December 2013.

Support activities

There are support activities but they are not as clear as in a big company. For example, the Human resources activity is recruiting workers and to pay their salaries. Workers are found nearby the farms and they do not need to be trained for the job. The same temporary workers are often used many times if they do a good job. The fact that no special skills are required and that there are a lot of people willing to work makes it easy to find labor to the farms. This is done by the farmer himself and no costs related to this activity could be found.

The technology development is not a noticeable activity, there is no active work done to develop the technique. The obvious technology on the farms is the water pump for irrigation, without it there would be no fertile land. Also technology for the plowing is important where different techniques are used, oxen and tractor or only oxen. Considering how tractors are used in the developed countries, the use of tractors might be the biggest development in the agricultural sector in Ethiopia in the future. From the answers on the use of fertilization and pesticides it looks like there are no general guidelines or know-how that the farmers use. One farmer said that the government sometimes sends out consultants to give the farmers free advices on the agriculture. One important improvement is that telecommunication now is available through mobile phones even in the rural areas. Farmers can now connect easily to the broker and other actors. On the question if the farmers plan to develop the farm, they answered that they want to have bigger croplands to increase the business.

All products used for the onion production is bought in agricultural shops nearby the farms. As discussed earlier, the prices can vary greatly. The reason can be either that the stores simply have different prices or that the farmers did not know the exact price at the time for the interview but answered what they thought was correct. All farmers answered that the prices are fixed and that the seed price depends on the season. There is no specific cost for this

activity other than the time spent and transportation to the shops. The farmers simply go to the shop when they need something.

The firm infrastructure consist of one single farmer that makes all decisions, hires labor, plan the production and keep track of the finance. Four of the six farmers were asked if they do accounting and only one answered that he does to control the costs. No business profit tax or income tax is paid. The only tax is the one for land owners. Planning the production is basically to sow at the right time so that the seedlings get ready in time and plan for the harvest. All farmers except one said that it is impossible to predict the selling price. One farmer planned the production so that he could harvest at a holiday when the price goes up. He expected to get three times the selling price just by harvesting at the right time when the demand is high.

Electricity from onion wastes

If the wastes from the farmer level are used to produce electricity as described in section 4.2, the value added would be 0.001 ETB per kilo produced onion, which means it is negligible compared to all costs.

Summation: Farmer

The activities excluded from Porter's value chain model are Outbound Logistics, Marketing and Service. The Outbound Logistics is excluded because it is done by the broker together with the wholesaler. There is no service on the product if it is of bad quality but it might affect the sales in the future. The total cost for onion production and the selling price can be seen in Table 6, presenting the six farmers as well as the average.

Table 6: Summation of the farmer stage in the value chain in ETB/kg of onions.

	F1	F2	F3	F4	F5	F6	Average
Production cost (ETB/kg)	4.22	3.66	3.70	2.53	3.86	4.09	3.68
Selling price (ETB/kg)	5.80	4.00	5.00	5.18	4.82	4.90	4.95
Profit (ETB/kg)	1.58	0.34	1.30	2.65	0.96	0.81	1.27

The support activities exist but the fact that these are small businesses makes it hard to identify and find costs for them. The big differences in the production cost are mainly because of the differences in usage of fertilizers and pesticides. The losses of onions due to bad quality are somewhat inevitable because of the weather impact on the agribusiness.

The Farmer step in the value chain can be summed in an illustration seen in Figure 31. The operations activity (3.67 ETB/kg) can be divided into material (2.37 ETB/kg) and labor costs (1.30 ETB/kg). The onions leave the farmer step at a value of 4.95 ETB/kg, which gives a profit of 1.27 ETB/kg to the farmer. All farmers interviewed in this study made a positive result.

Figure 31: The farmer step in the value chain. Costs given in ETB/kg.

4.3.2 Broker

No physical flow of onions takes place in this step of the value chain. The broker only works as a connection between wholesalers and farmers. Three brokers in the Meki and Ziway area were interviewed in this study. All interviewed farmers used a broker to find a buyer but not all wholesalers used one to find a seller. The wholesaler is the one paying for the brokers' services.

Primary activities

Since no physical flow takes place there are no inbound or outbound logistic activities in this step. The operations activity is to connect farmers and wholesalers so that a transaction can be made between these two actors. Since the transaction is made between wholesalers and farmers, there are no sales- or service activity. The brokers go out to the farms to check the quality of the onions before a wholesaler is involved. The brokers then discuss the price and quality with the wholesalers. One of the brokers gives money to the farmers as a guarantee that he will find buyers for the onions. When it is time to harvest the brokers hires wooden boxes to put the harvested onions in to weigh them in before they are put on the truck. The brokers are monitoring the harvest so that the onions are of good quality before they are transported to the wholesaler. The brokers also work with other vegetables and items to make a living. Wholesalers said that they pay from 500 up to 1500 ETB per truckload of 5000-6750 kg onions to the broker. The interviewed brokers are paid 1000-1200 ETB per truckload. The costs for a broker are transportation of himself out to the farms to check the quality and to monitor the harvest, telephone, rental of wooden boxes and a scale. All costs for the interviewed brokers can be found in Table 7.

Support activities

A broker has a one man business with no employees and no physical flow involved in the events. Procurements is only done to get a good price on behalf of the farmers, the brokers get paid the same amount no matter the price of the onions. The only technical device used is the mobile telephone. The phone is important to be able to keep contact with farmers and wholesalers.

Table 7: Presentation of the costs and income for the brokers in ETB/kg of onions.

Activity	B1	B2	B3	Average
Transportation to the farm	0.02	0.01	0.01	0.01
Rental of wooden boxes	0.02	0.03	0.02	0.02
Telephone	0.00	0.00	0.01	0.00
Scale rental	0.00	0.01	0.02	0.01
Costs Total	0.04	0.05	0.05	**0.05**
Income	0.20	0.22	0.18	**0.20**
Profit	0.16	0.16	0.13	**0.15**

Summation: Broker

The broker step in the value chain can be represented by Figure 32. The total cost found from the interviews with brokers is 0.05 ETB/kg. Interviews with both brokers and wholesalers show that the average payment to the brokers is 0.18 ETB per kg. From the total value added in this step, 0.13 ETB/kg is profit for the brokers.

Figure 32: The broker step in the value chain. A total value of 0.18 ETB/kg is added.

4.3.3 Transporter

Transportation of onions from Meki and Ziway area to Addis Ababa can be made either by a transport company or by a wholesaler owning a truck. Two of the nine interviewed wholesalers have their own truck and driver. Two transport companies were interviewed in Ziway. Transporter 1 uses an Isuzu registered for a maximum load of 3000 kg but is always loaded with around 5000 kg of onions. Transporter 2 uses an Isuzu registered to carry a maximum load of 3500 kg but is always loaded with about 6000 kg of onions. Both companies use their trucks for all sorts of loads and onion is one of the products regularly transported. The owners of the transport companies have two employees; driver and a helper. The drivers get 1200-1500 ETB per month plus 100 ETB per day they are out driving to cover food along the way. The helpers are paid 400-600 per month plus 50 ETB per day on the road. Transporter 1 gets 2000 ETB for the transportation of 5000 kg of onions to Addis Ababa and transporter 2 gets 2200 ETB for the 6000 kg transportation. The interviewed wholesalers pay from 2000 up to 4150 ETB for truckloads ranging from 4800 kg up to 7000 kg. Information from both wholesalers and the two transporters has been used to calculate the average payment from the wholesalers to the transport companies, which is 0.47 ETB/kg. The two wholesalers with their own truck use the same type of trucks as the transporters. Since the transportation is the same for the wholesalers and transporters, information from both actors

has been used to get a more accurate picture of the transportation costs; this is shown in Table 8.

Primary activities

As discussed earlier, this is small companies with just a few employees and not very distinct activities. Inbound logistic of material needed for the operations is mainly filling up the truck with fuel at a petrol station. Service and spare parts are also needed but are included in the operations stage. The outbound logistics of the service provided by the transport company is the operation itself and is completed when the onions are unloaded in Addis Ababa. The sales of the transportation service are mostly through telephone; the broker or wholesaler contact the transporters when needed. No customer service or marketing can be found in these companies. Therefore the only primary activity is the operation; transportation of onions from Meki and Ziway to Addis Ababa. The costs found for the transportation from both transporters and wholesalers are shown in Table 8 and are represented in ETB/kg of onions. The fuel consumption per kg of onions can be calculated from the fuel cost. The average is 0,01 liter of diesel per kg onions.

Table 8: Costs for the two transportation companies and transportation costs for the two wholesalers with their own trucks. ETB/kg of onions.

	T1	T2	Average T	W1	W3	Average T&W
Truck	0.02	0.04	0.03	0.03	0.02	0.03
Fuel	0.20	0.22	0.21	0.36	0.17	0.24
Service	0.06	0.04	0.05	0.08	0.04	0.05
Taxes	0.00	0.00	0.00	0.00	0.00	0.00
Labor	0.03	0.02	0.03	0.03	0.01	0.02
Costs Total	0.32	0.32	0.32	0.50	0.24	0.34
Income	0.40	0.37	0.38	-	-	-
Profit	0.08	0.05	0.07	-	-	-

Support activities

There are support activities like finding employees, paying salaries, finding and buying new trucks and to pay taxes to the government but no costs related to these activities could be found in the transportation companies.

Summation: Transporter

The transporter stage in the value chain is shown graphically in Figure 33. The interviewed transporters were both paid in the lower end of the range. The average payment for the transportation is 0.47 ETB/kg whilst the total cost for transportation is 0.34 ETB/kg. The profit made by the transport companies is therefore 0.13 ETB/kg. The profit made by the interviewed transporters is lower since they received under average payments for their services.

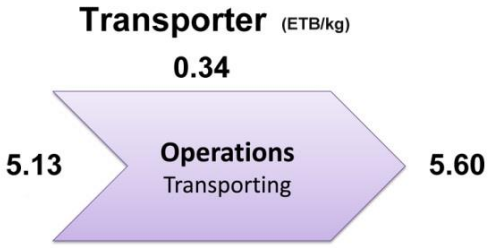

Figure 33: The transportation from Meki and Ziway area made by transportation companies.

4.3.4 Wholesaler

The nine interviewed wholesalers have their businesses located in the same area, the fruit and vegetable market Atkilt Tera near Piazza in Addis Ababa. The onion price varies over the year. At the time for the first interviews, the price at the vegetable market was the same as the farmers selling price at the latest harvest. The value added in this step has therefore been calculated on the basis of costs and profit given the buying and selling price from the wholesalers. The price paid to the farmers ranged from 2 up to 5.5 ETB/kg. The selling price at the vegetable market ranged from 4.5 up to 7.5 ETB/kg. The businesses are similar to each other but there are some differences. Two of the nine wholesalers have their own truck and manage with the transport themselves. All of the wholesalers except one pay workers at the farm to load the truck, the same wholesaler never use a broker. The sale rate differs among the wholesalers; some sell one truckload per day while one sells one truckload per week. The size of the truckloads and the sale rate for the wholesalers are shown in Table 9. If other fruits and vegetables are sold by the wholesaler, the costs for the onion sales at the marketplace have been calculated using the percentage of onions from the total sale. How many percent the onions take from the total sales are found in Table 9.

Table 9: Truckload sizes, sale rate and percentage of sales that are onions for the wholesalers.

	W1	W2	W3	W4	W5	W6	W7	W8	W9	Average
Truckload (kg)	5000	6750	6000	4900	5500	5500	6500	6000	6000	5794
Sale rate (kg/day)	1733	4988	5900	4890	1823	2638	6495	771	2942	3575
Percentage of sales	50	100	75	33	90	100	100	100	100	83

Inbound logistics

The transportation of the onions from the farms to Atkilt Tera in Addis Ababa is described above. The transport and the brokers' services are paid by the wholesalers. One wholesaler does not use a broker but takes help from a relative, living in the farming area, to find onion farmers. As mentioned above, eight of the wholesalers pay workers at the farm to load the truck. Two wholesalers also pay for the harvest workers at the farm. The farmers interviewed for this study all paid for the harvest workers themselves. Workers that do the loading of the truck at the farm are paid 400 up to 3000 ETB. Harvest workers are included in the cost for two of the wholesalers. When the truck arrives in Addis Ababa there are workers that unload the trucks. There are dedicated workers that do the unloading of trucks for many wholesalers, or wholesalers can use their own employees. In the case where own employees are used, part

of the total labor cost has been noted as unloading of the trucks in the calculations. All Costs in the inbound logistics activity are labor related. All inbound logistics costs are shown in Table 10 and give the average inbound logistics cost of 0.38 ETB/kg.

Table 10: Cost for inbound logistics for the wholesalers in ETB/kg.

Inbound logistics	W1	W2	W3	W4	W5	W6	W7	W8	W9	Average
Loading	0.23	0.38	0.51	0.10	0.46	0.23	0.00	0.46	0.46	0.31
Unloading	0.03	0.11	0.10	0.02	0.16	0.09	0.03	0.04	0.05	0.07
Total Cost	0.26	0.48	0.61	0.12	0.62	0.32	0.03	0.50	0.53	**0.38**

Operations/Sales

The wholesalers' function is to buy onions from the farmers and get them to Addis Ababa where they are sold to consumers or retailers. Labor, store rental, plastic bags, wooden boxes for storage and scale rental are expenses for the wholesalers found at the vegetable market. The costs can be found in Table 11. Employees can get paid on a daily or monthly basis; a typical salary is 100-300 ETB/day. The cost for renting a sales place at the market varies between the wholesalers. It can be rented from a private owner or from the government. Private rental can be up to 1200 ETB per day while governmental rental can be as low as 500 ETB per month.

Only two of the nine wholesalers give plastic bags to their customer, the rest of the wholesalers let their customers buy bags from vendors on the street. Most of the wholesalers use wooden boxes for storage at the market. It is the same type of boxes that are used at the harvest. Onions are often just put on the ground at the marketplace and stored in boxes at night, which can be seen in Figure 34.

Figure 34: Onion business. A wholesaler is selling onions at the fruit and vegetable market, Atkilt Tera.

Onion losses at the market range from 5 kg up to 600 kg. Wholesaler 1 was the only one stating that too much moister in the onions from the farms led to a significant weight loss before they are sold at the market. 200-300 kg in weight loss per truckload of 5000 kg is included in the post "onion losses", although that is not real onion losses. Three of the wholesalers answered that they rarely or sometimes have onion losses during the transport. Since they could not specify the exact amount or how often it happens, calculations are made on the normal case with no losses during the transport. Including the weight loss for wholesaler 1 gives a cost for onion losses of 0.13 ETB/kg, if only real losses are used in the calculation, the result is 0.11 ETB/kg.

The average of the total operations/sales cost is 0.42 ETB/kg. W8 has the highest total cost because of the amount of losses and the low sale rate. The wholesaler with the lowest total cost has a high sale rate and the costs at the market place are shared with the other products.

Table 11: Costs at the marketplace for wholesalers.

Operation/sales	W1	W2	W3	W4	W5	W6	W7	W8	W9	Average
Labor	0.09	0.12	0.05	0.02	0.11	0.28	0.03	0.48	0.25	0.16
Premises rental etc.	0.00	0.27	0.13	0.04	0.03	0.19	0.19	0.13	0.12	0.12
Onions losses	0.26	0.03	0.05	0.01	0.02	0.22	0.00	0.50	0.10	0.13
Total	0.35	0.43	0.23	0.06	0.16	0.70	0.23	1.11	0.48	**0.42**

Outbound logistics

Most of the customers come to the market to buy onions. None of the interviewed wholesalers transported onions to their customers. The interviews with the restaurants in this study showed that it is common that onions are bought from wholesalers that also handle the transport from market to restaurants. The transport cost is then included in the onion price. Since none of the interviewed wholesalers provided this service, the costs are not known. Some of the wholesalers did have agreements or contracts with buyers so that they get a better price at the market.

Support activities

The whole fruit and vegetable market is crowded with people and it is not always clear if they work at the market or are just observers that try to make some money by helping whenever there is a chance for it. There are no special skills required for working at the market which means that finding labor would not be a problem with all unemployed people at the market. The wholesalers do not need much to run their business; the main procurement is onions, which is negotiated with the broker to get the best possible price. As mentioned in the earlier stages of the value chain, the mobile telephone is a very important technique tool to run the business. It is used every day to make sure there are onions to be delivered the next day. Some of the wholesalers use a receipt printer but other than that there are not much technical tools. When the transportation is made by the own truck, there is also an importance in the truck as a technical tool. To find and buy trucks of good quality then becomes an important activity.

All wholesalers have an annual turnover exceeding 500,000 ETB and should therefore include VAT in the selling price to pay to the government. At the first interview, three of the wholesalers stated that their selling price included VAT, but on follow up interviews they answered that they did not. This resulted in that none of the interviewed wholesalers included VAT as a standard procedure. The only time the value adding tax is used is when restaurants and retailers buy and need a receipt for their own accounting. At one wholesaler onions were bought as a test. The price were said to be 7 ETB/kg including 15 % VAT. The receipt showed that 7 ETB did not include VAT, 7 ETB were paid even though the receipt stated that more money were paid.

Taxes on the profit from the business are only paid by three of the wholesaler. 35 % on the profit is paid from one of them. According to the two other, they do not need to pay a certain percentage of the profit, they just tell the tax office how big the profit is, they are then told how much to pay. Both these wholesaler paid about 8,000 ETB per year in profit tax.

Pricing

When the wholesalers were asked how they determined the selling price at the market they answered that they make a calculation to cover all expenses and then add some extra to make a profit. The wholesaler making the greatest profit added 3.8 ETB/kg to the price from the farm. No broker was used and no workers were paid to load the truck at the farm. When transportation and everything else is paid, a profit of 3.2 ETB/kg is made. A truckload of 6500 kg per day with only 5 kg losses, the total daily profit is over 20,000 ETB. This wholesaler

stands out for making far better profit than the other wholesalers. Up to 5 ETB per kg could be added by the same wholesaler, which of course makes the profit even bigger. On the question if it was a competitive market to sell onions the wholesaler making the biggest profit was the only one answering that it was not competitive. The other wholesalers answered that they treat the customers nicely, give them a good product and are trustworthy with the scale to get customers to come back. Table 12 shows the profit/kg for all the wholesalers. W9 have negative profit with calculations on the information from the interview. Since no wholesaler would be in the business with negative profit this information is not completely right. The negative number has not been used to calculate the average since it is not representative for the market.

Table 12: Profit made per kg of onions for the nine wholesalers.

	W1	W2	W3	W4	W5	W6	W7	W8	W9	Average
Profit	0.09	0.82	0.78	0.18	0.55	0.55	3.20	0.33	-0.10	0.72

Electricity from onion wastes

If the wastes at the wholesaler stage in the chain are used for production of electricity as described in section 4.2, this would add 0.002 ETB per kilo of onions, which is negligible, compared to all costs.

Summation: Wholesaler

The calculated cost for inbound logistics, operations/sales and profit gives a total value of 1.52 ETB/kg added in this step of the value chain, which is represented in Figure 35. The outbound logistics & customer service is represented because information from interviews with restaurants tells that some wholesalers provide delivery service and also replace onions of bad quality as a guaranty. The profit made in this step is 0.72 ETB/kg of onions.

Figure 35: The wholesaler step in the value chain for onions. Total value added is 1.52 ETB/kg.

4.3.5 Retailer

Two different kinds of retailers were interviewed; small fruit and vegetable stands out on the streets (Figure 36) and supermarkets that have a big assortment of food products. They all buy their onions from the vegetable market at Atkilt Tera. At the time for the interviews, the retailers pay 5.5-7.5 ETB/kg at the market and sell the onions for 7-15 ETB/kg (excluding VAT). How much onions that are sold can be seen in Table 13. R1, R2 and R7 are small family businesses. R3, R4 and R5 are supermarkets. R6 is a vegetable restaurant that also sells vegetable.

Table 13: The amount of onions sold per week for the seven retailers.

	R1	R2	R3	R4	R5	R6	R7	Average
Sale rate (kg/week)	145	146	297	19	290	32	36	138
Added on price (ETB/kg)	2.45	0.50	0.96	7.61	2.04	1.83	1.50	**2.41**

Figure 36: A retailer's fruit and vegetable stand in Shiro Meda.

Inbound logistics

Three of the seven retailers are supermarkets from which two have their own car that they use for transportation. One driver and a purchaser go to the market to buy all fruits and vegetables for the store. The cost for the transportation of onions is hard to know since the car and employees are used to more than just onions. The cost for one of the supermarkets is only calculated from the fuel consumption for one trip to the market while the other supermarket estimated the cost to 80-100 ETB for one round-trip to the market. The third supermarket got their onions delivered from the market to the store with the transportation cost included in the price. For the small businesses on the streets, public transportation is used. Some of the minibuses that build up Addis Ababa's public transportation can also be used to transport goods. 16-30 ETB per 100 kg is paid by the four retailers using this service. The transportation cost per kg is shown in Table 14.

Table 14: Inbound logistics for retailers in ETB/kg.

	R1	R2	R3	R4	R5	R6	R7	Average
Inbound logistics	0.50	0.16	0.91	0.00	0.19	0.28	0.33	**0.39**

Operations/Sales

As mentioned above, the supermarkets have big stores with a wide range of products. Therefore, the costs for labor, premises rental etc. could not be specified to the onions. Three of the four vegetable stands are family businesses where family members work and nothing is paid for labor; the profit is the family's salary. One of the family businesses hires a guard to protect the vegetable stand during night time. Rental cost for the stands goes from 200 ETB/year up to 1000 ETB per month for the family businesses. Table 15 shows the retailers' cost. Onions of low quality and sold to a reduced price are included in the cost for onion losses. R7 sells 25 % of the onions to a reduced price, far below the purchase price, which explains the high cost. The cost for onion losses is 0.33 ETB/kg if the calculation is made with only real losses.

Table 15: Cost in ETB/kg for the retailers operations.

Operation/Sales	R1	R2	R3	R4	R5	R6	R7	Average
Labor	0	0	-	-	-	0.87	0.69	0.39
Premises rental etc.	0.03	0.63	-	-	-	0.27	0.73	0.42
Onion losses	0.27	0.96	0.06	0.24	0.20	0.67	2.24	0.66
Total	0.30	1.60	0.06	0.24	0.20	1.81	3.66	**1.47**

Support activities

The supermarkets are big businesses that need all the support activities while the only support activity in the family-run businesses is purchasing done at the market by one of the family members. As mentioned earlier, supermarkets have many more products than just onions. Therefore, no costs were found specifically for the onions. The supermarkets and the restaurant include 15 % VAT in their selling price.

Summation: Retailer

Inbound logistics average cost is 0.39 ETB/kg and the operations average cost is 1.47. The average price added to the onions purchasing price is 2.41 ETB/kg, which results in a profit of 0.55 ETB/kg. This is not true for all the retailers; four of the seven retailers have a negative result and one of them stated that they have to have a minus result on the onions to get customers to buy other products in the vegetable stand, therefore the minus results have been used to calculate the average. Figure 37 shows a representation of the retailer.

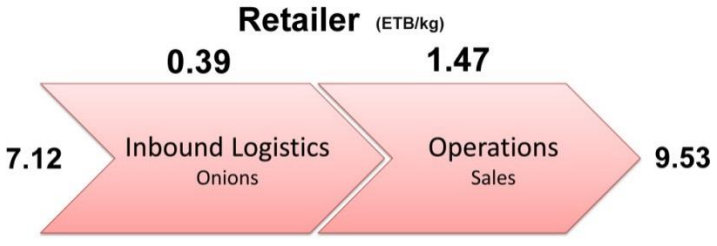

Figure 37: Representation of the retailer step in the value chain.

4.3.6 Consumer

The consumers in this study are restaurants. They buy their onions from wholesaler and if there is an extra need they can buy from a local retailer. The price paid for the onions range from 4.5 ETB/kg up to 15 ETB/kg. How much onions that are purchased every week and how big the losses are is presented in Table 16.

Table 16: Purchased amount of onions per week and losses for the nine restaurants.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	Average
Purchased per week (kg)	600	30	48	250	22.5	70	75	210	30	148
Losses (%)	2.8	1.7	16.7	12.0	2.2	7.5	2.0	1.0	1.7	5.3

Inbound logistics

Five of the nine restaurants buy their onions from wholesalers with delivery service and the transportation cost is then included in the price. The rest of the restaurants have their own car that they use for all vegetable purchasing from the market. The calculated cost shown in Table 17 only includes fuel since costs for labor and the car related to the transportation is not known. The average cost for inbound logistics is calculated from the four restaurants with their own car. Assumptions are made that the same amount of fuel is used by the wholesalers to deliver the onions, and therefore added to the onion price. If the restaurants buy their onions from a retailer, there is no transportation cost since the onions are bought near the restaurants. The fuel consumption for the transportation from the market to restaurants and retailers is 2-3.5 liters per trip, which results in 0.04 liter/kg of onions.

Table 17: Transportation cost in ETB/kg.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	Average
Transportation	0.13	0	1.35	0.29	0	0	0	0	1.2	0.75

Summation: Restaurant

There are different ways for the onions to reach the final consumer. If the restaurants buy from a wholesaler at the big vegetable market, the price for the used onions is the wholesale price plus the transportation, the sum is then corrected for the consumer losses to get the total cost for the used onions. If the restaurants instead buy their onions from a local retailer, the retail price corrected for losses is the total price. These two cases are represented in Figure 38.

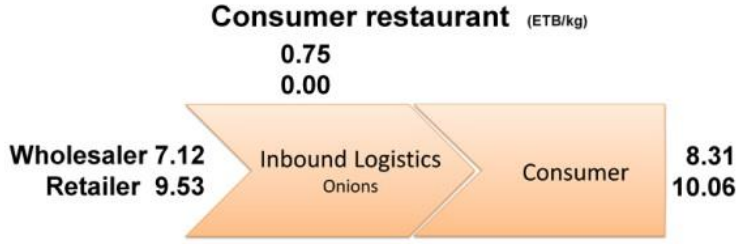

Figure 38: Consumer representation of a restaurant. The upper figures are for wholesaler sold onions and the lower figures are for retailer sold onions. In ETB/kg.

4.3.7 Summary of the value chain

The whole chain from farmer to consumer consists of six steps as described in previous chapters, but in some cases not all of the steps are included. All wholesalers except one use a broker to find a farmer to buy onions from, thus there is a chain with the broker excluded. Two of the wholesalers use their own truck for transportation from farmer to the market in Addis Ababa, which means that the chain has no transport company. Consumers can purchase onions from both wholesalers and retailers, buying from the wholesalers exclude the retailers from the value chain.

Figure 39 shows the complete value chain with all six actors. This chain is valid mainly when households are the consumers since the normal case for the restaurants is to buy from the wholesalers. The profit and labor-cost for each stage of the chain is shown in Table 18. Only the paid employees are included in the labor cost. Since the owner of the businesses in each stage takes the profit as salary for the work, this is not included in the labor-cost, which explains why the broker has a zero cost for labor.

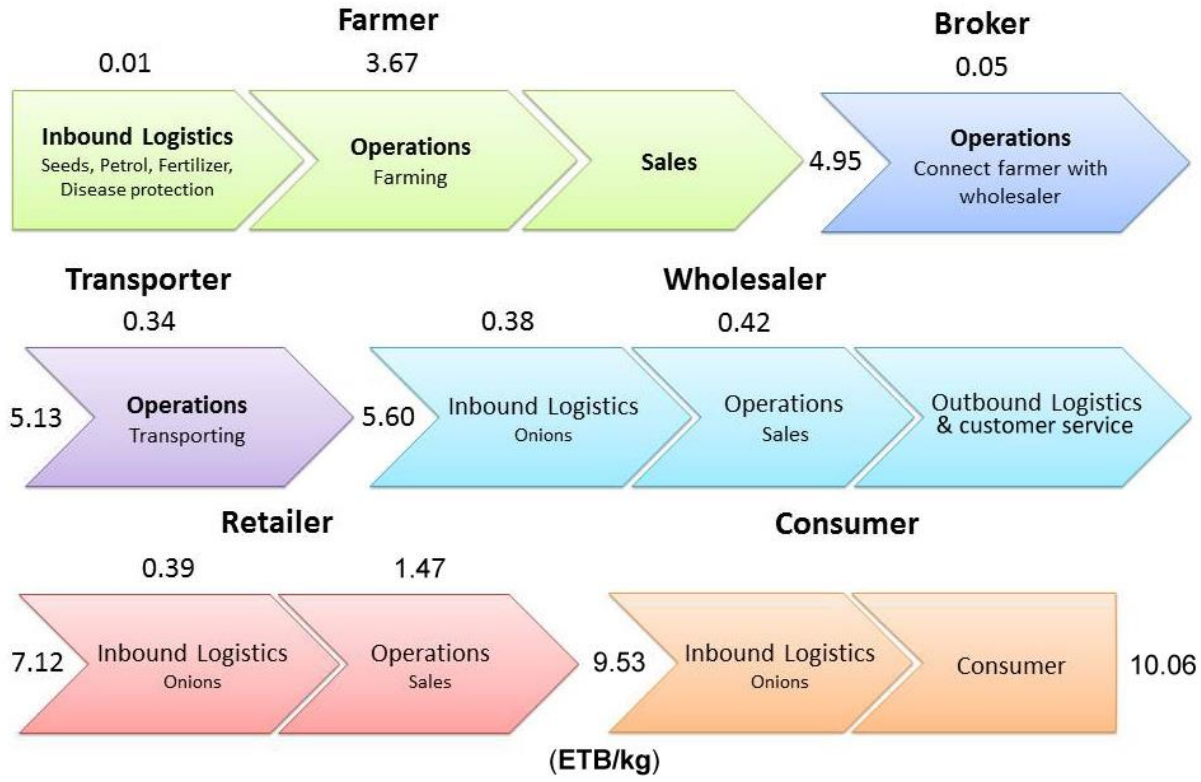

Figure 39: The complete six step value chain, from farmer to consumer, for onions in Ethiopia.

Table 18: Summation of the value chain with all six actors.

	F	B	T	W	R	C	Total
Value added (ETB/kg)	2.58	0.18	0.47	1.52	2.41	-	7.16
Profit (ETB/kg)	1.27	0.13	0.13	0.72	0.55	-	2.80
Labor (ETB/kg)	1.3	0	0.02	0.54	0.39	-	2.25
Share of value added (%)	36	3	6	21	34	-	100
Share of profit (%)	45	5	5	26	19	-	100

The farmers buy products for 2.37 ETB/kg of onions, the value of 7.16 ETB/kg is added trough the value chain so that the price to the consumer reach 9.53 ETB/kg. The consumers throw away about 5 % because of bad quality and the price per kilo used onions then reaches 10.06 ETB/kg. The total profit in the chain is 2.80 ETB/kg from which the farmers get 45 % and the wholesalers 26 %. Just by looking at the numbers, it seems like the farmers are the one making the most money from the onion businesses. The interviewed wholesalers had an average sale rate of almost 3600 kg/day while the farmers sell an average of 15,250 kg in a four months period. The results are that the yearly profit for the average wholesaler is more than 900,000 ETB while the average farmer's yearly profit is about 58,000 ETB.

The value chain without the retailer is represented in Figure 40. The only differences are that the consumers buy their onions directly from the wholesalers and that they pay for transportation from the market.

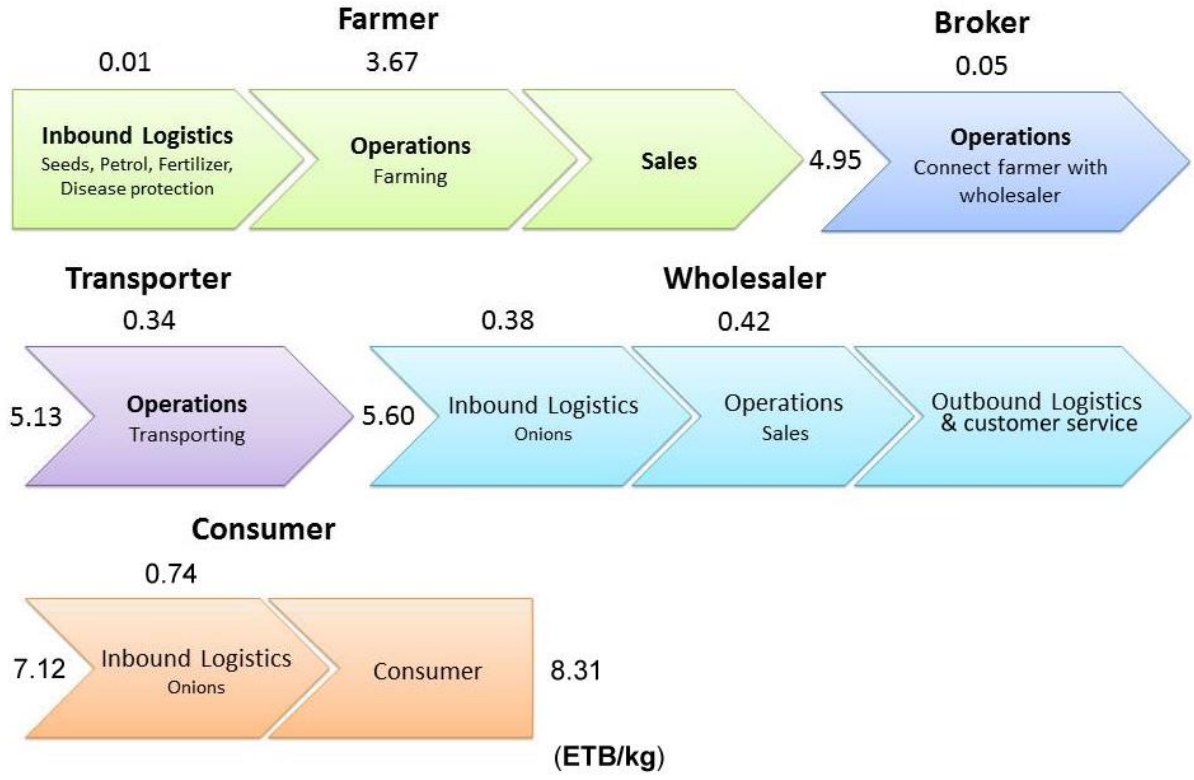

Figure 40: The value chain when the consumers buy their onions directly from the wholesalers.

When skipping the retailer step in the value chain the cost for one kilo of onions is 8.31 ETB in the end of the chain instead of 10.06 ETB. The total value added and the made profit can be seen in Table 19.

Table 19: Summation of the value chain with the retailer excluded.

	F	B	T	W	C	Total
Value added (ETB/kg)	2.58	0.18	0.47	1.52	0.74	5.49
Profit (ETB/kg)	1.27	0.13	0.13	0.72	-	2.25
Labor (ETB/kg)	1.3		0.02	0.54	-	1.86
Share of value added (%)	47	3	9	28	13	100
Share of profit (%)	56	6	6	32	-	100

The wholesalers do not pay differently to the farmer if a broker is used or not. The broker is then excluded from the chain and the wholesaler gets a higher profit. The same thing happens when the wholesaler owns a truck to do the transportation from the farms to the market. The transporter step in the chain is excluded and the wholesaler makes the profit.

The overall onion losses, including weight losses and low quality sold to a reduced price, add 1.46 ETB/kg to the total end-value for the longer chain and 0.65 ETB/kg for the chain without the retailer. The results when only including the real losses are 1.06 and 0.58 ETB/kg for the whole and reduced chain respectively. Value added because of losses and bad quality is shown in Table 20. Real losses can also be onion peels, which cannot be used for cooking.

Table 20: The value added in the two chains because of bad quality and losses.

ETB/kg	F	B	T	W	R	C	Total	Percentage of end-value
Real- and quality losses	0.11	0	0	0.13	0.66	0.56	1.46	14.5
Real losses	0.06	0	0	0.11	0.33	0.56	1.06	10.5
	F	**B**	**T**	**W**	**C**	**Total**	**Percentage of end-value**	
Real- and quality losses	0.11	0	0	0.13	0.41	0.65	7.8	
Real losses	0.06	0	0	0.11	0.41	0.58	7.0	

Energy used by pumps and vehicles

The total amount of energy used in the chain, from framer to consumer, can be calculated from the fuel consumption in each step of the chain. Pumps used for irrigation at farmer level consume 0.03 liter of diesel per produced kilo of onions. Transportation from farmer to Addis Ababa is made by trucks that consume about 0.01 liter diesel per kilo of onions they transport. Transportation from the market to restaurants and retailers is made by cars, which consume 0.04 liter of petrol per kilo of onions. The total fuel consumption in the whole chain is therefore 0.04 liter of diesel and 0.04 liter of petrol. Using the conversion factor from Energimyndigheten (Energimyndigheten [no date]), the fuel consumed in the supply chain corresponds to 0.75 kWh per kilo of onions.

5. DISCUSSION

The purpose of the study was to investigate and understand the logistic chain for fruits and vegetables in Ethiopia today and the complete chain for onions has been presented in this report where the main actors where found out to be:

- Producers, i.e. farmers
- Brokers
- Transporters
- Wholesalers
- Retailers
- Consumers

5.1 SUPPLY CHAIN FOR ONIONS IN ETHIOPIA

The method used in this study was interviews with participants from each chain level. There is considerable uncertainty with this procedure of gathering information since translators were needed. The use of translators meant that some information might have been lost and follow up questions was sometimes not applicable when the translators did the whole interview. The number of interviews was less than planned since it was hard to find people who could do the translation and the time in Ethiopia for conducting the study was limited.

The aim of this report was to map out the logistic chain for onion in Ethiopia to see if there were any losses and if so where they occur. The conclusion from this study is that the total amount of losses is about 13% in the onion supply chain between Meki/Ziway and Addis Ababa and even as low as 9% for the alternative chain without the retailers. As mentioned in the introduction of the report previous studies have shown that fruit and vegetable losses in Ethiopia range between 15% and 70%, the result from this study is thus lower than the studies made by *African Fruits*. This is most probably an outcome from the fact that onions are very durable and resistant to mechanical stress and other outer strains. An onion load can easily be piled up on trucks and in storage rooms without any notable negative effect on the vegetables. Onions have a fairly long storage period, which also increases the onions durability. Since the losses are low and the losses that occur are mostly due to heavy rain and rejection of the non-edible onion peels the need to find ways to reduce post-harvest losses is not very high. The farmers throw away 1.7% of the harvested onions, which corresponds to 13% of all the losses in the chain from farmers to consumers with retailers included and 19% without the retailers. Heavy rains cause the losses that occur at farmer level during the rainy season. The farmers cannot control this factor and thus not do much to reduce the post-harvest losses. There are no onion losses for transporters; the losses that might have been applied to the transporters are displaced to the wholesalers instead since the wholesalers are the ones who try to sell the onions that might have gotten damaged during the transportation. The brokers' role in the chain is mainly to connect chain actors with each other and share information between and among chain actors, there is no physical flow through this step and hence no losses. The wholesalers throw away 2.3% of the purchased onions and that corresponds to 17% of all the

onion losses in the chain when retailers are included and 25% without the retailers. Much of the losses at wholesaler level are no actual losses though, it is mostly dry onion peel that the wholesalers throw away. The retailers throw away 4.7% of the purchased onions and most of the waste is, as well as for the wholesalers, only dry onion peel. Finally the consumers (restaurants) throw away 5.3% of the bought onions, which corresponds to 36% of the total onion losses in the chain with retailers included and 56% of all onion losses without retailers. Table 1 and 2 also illustrate how the losses increase downstream of the supply chain with maximum losses at consumer level. This is an outcome from the fact that bad onions are mixed with the good onions earlier in the chain by farmers and wholesalers and are thrown away by the retailers and especially by the restaurants. The bad onions have thus been transported and sold all the way from the farmers only to be thrown away later in the chain. The credibility of the farmers and the wholesalers as the cooperation between chain actors could increase if the bad onions were instead sorted away directly. To mix good onions with bad ones may also have a bad impact on the previously fresh onions by mold and other diseases spreading from the bad onions. It would be better if the bad onions were sorted away directly and used in for example a biogas digester or as compost. If the onions of low quality would be used as compost, the nutrients would then be carried back into the soil and available to improve future harvests.

The supply chain for onions in Ethiopia is very fragmented with little if any cooperation between the chain actors. This fragmented system has no planning or control, each member in the different chain levels is only concerned about their own business without any exceeding organization to optimize the process. The fragmentation of the chain causes a non-collaborative system, which in turn result in the higher amount of losses in the end of the chain. The interdependency between the chain actors and thus the propagation of impacts made on the chain may be harder to detect in a fragmented chain. If the interdependency and propagation would be easier to see, it would probably be easier to prevail negative impacts and promote the positive ones.

It could be possible to achieve less transportations and a higher quality of the end product if the bad onions were sorted away earlier in the chain instead of mixed in with the onions of good quality, in other words: the environment and the quality of the end product would benefit of a functioning synergy in the chain.

There exists some cooperation among the chain actors at the same level, for example some farmers borrow tools from each other and some retailers can use the same labor for transportation/carrying of fruit and vegetables from the roads through the markets to the stands. This kind of cooperation is good for a higher efficiency of the chain. Organization of mutual transportations for chain actors in the same area could decrease the environmental impact and might gain the individual chain actors as well. Cooperation between farmers might give them a stronger position towards the other chain actors.

In a study of post-harvest losses of ware potatoes in Ethiopia the conclusion was that the average harvesting loss was 12.3% of total production. The highest postharvest loss for

potatoes was found to occur at market level and the lowest occurred at household level. (Misrak et.al 2013). The conclusion from the potato study showed a similar result of the amount of postharvest losses as the postharvest losses of onions but is opposite of the conclusion from where the losses occur. The highest postharvest losses occur at household level for onions, which was where the lowest postharvest losses were found for potatoes.

A study of postharvest losses of tomatoes in Ethiopia showed that tomatoes are very vulnerable to mechanical stress and need extra careful handling while transported (Zenebe, 2013). Onions are not as fragile as tomatoes, which is why the packaging in wooden boxes without upper covering and transporting in vibrating Isuzu trucks are more suitable for onions than tomatoes.

Ethiopia is a country in fast development and the supply chain of onions can benefit from the forthcoming improvements of the infrastructure. Better roads, railways, communication tools such as a reliable mobile net, power supply and Internet will increase the possibilities to improve the supply chain drastically. The time for transportations will be decreased and information between the chain-actors will most probably be increased which will benefit the environment as well as the supply chain.

5.2 ENERGY EXTRACTION FROM ONION WASTES

Today, onion wastes are used as compost and cattle feed but the wastes can also be used to produce biogas, which can be converted into electricity thorough fuel cells. In this study it was of interest to find uses that can add value to the onion production, which production of biogas/electricity does. The production of biogas is a relatively easy and well-known technique to extract energy from biological residues.

It was calculated in chapter 4.2 that a stove could be used for 30 hours per farmer and year based on the assumption that the farmers only used wastes from onions to feed the biogas digester. The number of hours that each farmer in reality could have a stove burning would be much higher since it is not likely that the farmers would feed the biogas digester only with onion wastes but with all their bio-digestible wastes. To receive the results of biogas from onion wastes mentioned in the results and in the conclusion it must be a constant flow of onion wastes, which means that all farmers must cooperate with the biogas production. Some examples of issues that would have to be solved are; where would the biogas power plant be situated, who will use the produced biogas or electricity, how would the farmers get paid for their contribution to the feeding.

Smaller biogas plants for household use can be an alternative at farmer level if the farmer has livestock to feed the digester with dung throughout the year. The onion fields will only contribute to the biogas production three times per year during harvest and can therefore not give a continuous flow of biogas.

It might seem a bit confusing that the profit from selling electricity converted by a biogas fuel-cell is quite low, only 10.5 ETB per farmer and year while the impact on the total

electricity consumption in the area is covered with up to 5.7%. This is due to the fact that both the price for and the usage of electricity are low in Ethiopia. The actual profit is lower than 10.5 ETB per farmer and year since neither the investment nor maintenance cost is included in the calculations.

5.3 VALUE CHAIN ANALYSIS

All the information used for this study was gained through interviews and there have been difficulties related to them. The first noticeable problem was that the interviews were very time consuming and time were taken from the interviewees. Questions sometimes had to be rushed through to avoid taking too much time from the respondents. The translator sometimes made the interviews with help from questionnaires. There are two problems related to this: The translator has to know exactly what the questions aim for to know if the answers are satisfying and that it is not possible to come up with relevant follow-up questions during the interviews. The language is another problem and information might be lost in translation from Amharic to English and vice versa.

During the study, it was in some cases revealed that the interviewees were not always giving a correct/true answer and corrections have sometimes been made. It might be by mistake but in some cases it can also be on purpose. For example when the first interviews with the wholesalers were made, three of them answered that they included VAT in the price. The calculations brought suspicions when the wholesalers got negative results. The wholesalers changed their answers when follow-up interviews through phone were made. The interviewees might have thought the purpose with the interviews was to see if they followed the tax-regulations. Another wholesaler thought that the purpose was to investigate the market with the goal to open up an onion business. The fear to get a new competitor might have affected him to answer in a certain way. Four of the retailers have a negative profit from the onion sale. If the retailers thought that the interviews were made by the government to control their profit, they might have given answers to give the appearance of poor profitability.

Another interview related problem was that it was hard to find translators, which resulted in that the number of interviews did not reach the planned. More interviews would be needed to make the study more reliable. As described in the literature study of a value chain, data should be collected over a longer period to get a reliable analysis of the value chain. This study was however conducted with a limitation in time, which also affected the number of interviews.

Information is sometimes missing from the interviews and the average has been calculated from known information from other interviews. In the retailer stage, labor and premises costs for the supermarkets are not known because of the nature of their businesses. The average is instead calculated with data from retailers with a different type of sales. The transportation cost is for some retailers and restaurants only an approximation made from the fuel consumption for a car. The cost should include the car itself and labor cost for the driver and purchaser that go to the market to buy onions.

Data were collected over a period of about two months. The onion price varies over the year and can change from day to day. For example, the price level at the wholesales was higher in the later interviews than the earlier. This might affect the costs and profits throughout the whole chain. The interviews should, preferable, be carried out at the same time to get the same price level throughout the chain. The best case would be to follow a specific truckload of onions, from farmer to consumer, to get all the right data related to that specific onion harvest. This was however not possible in this study.

Although the data is not very precise because of all uncertainties in the data collection, the results are presented with two decimals. This is to be able to see all value adding activities and the difference and relations between them. If the results would be given with less accuracy, some of the activities would be noted as zero with lost information as a result.

Despite some inevitable sources of possible errors that might have given incorrect data to the study, the resulting value chain is in the range of what the field studies showed. Here by follows a discussion of the results:

To strengthen farmers' role in the chain, they can establish an organization where all farmers agree on the lowest price they can accept to cover all expanses and give some profit. All farmers except one said that it is impossible to predict the selling price when it is time to harvest. With a lowest-price they would get a more secure business by knowing the minimum income they will get.

The difference in usage of pesticides and fertilizers among the farmers are important from an environmental as well as economically point of view. Pesticides can also cause health related problems. It would be a good idea to teach the farmers how agribusiness can be conducted to get the highest yield and at the same time consider economy and the impact on the environment. One farmer said that a consultant from the government sometimes came to give advices on the farming.

The reason why VAT is not applicable might be that if not everyone is doing it, customers not requiring a receipt will simply go to the wholesalers not adding the VAT because it is cheaper. The profit tax is paid from only three wholesalers, and the question is if receipts are not issued, how will the government know how big the profit is and how much that should be paid in tax? The importance of a working tax-program for a developing country like Ethiopia can be discussed in another context.

6. CONCLUSIONS & RECOMMENDATIONS

The conclusion from this study is that the total amount of losses is about 13% in the onion supply chain between Meki/Ziway and Addis Ababa and 9% for the alternative supply chain without the retailers. The reason for onions to go bad is mainly heavy rain and some of the losses are the non-edible onion peels. Onions are durable and resistant to mechanical stress and other outer strains. Onions also have a long storage period. Most losses appear at the last

stage of the chain, at consumer level where 36% of the total onion losses appear with retailers included and 56% of all onion losses without retailers, mostly due to the fact that bad onions are mixed with good onions throughout the chain. The studied supply chain proved to be a fragmented system with little cooperation between chain actors and no exceeding organization to optimize the process by planning and control. Less transportations and a higher quality of the end product could be achieved if the bad onions were sorted away earlier in the chain instead of mixed with the onions of good quality. Improvements of the infrastructure in Ethiopia with better roads, railways and communication tools such as a reliable mobile net, power supply and Internet will increase the possibilities to improve the supply chain of onions.

The biogas from onion wastes can be used as fuel in gas stoves for cooking and can keep a stove burning for about 30 hours per farmer and year.

There is value in the wastes from the onion production that is not currently considered. 5.7 % of the electricity consumption in Ziway and Meki could be covered by fuel cells powered by biogas from onion wastes. The corresponding economic value of the potential energy extraction from onion wastes at farmer level is 200,000 ETB per year, which can be compared to the total value of onions at this level; over 800 million ETBs per year.

The wholesaler is the actor in the chain making the most money from the onion business. Even though the farmer is the one with the highest profit per kilo, the low number of harvests per year makes the wholesaling far more profitable. The onion price varies widely over time. Interviews with wholesalers showed that the price from the farmers can get as low as 2.20 ETB/kg, which is lower than the production cost for onions. The lowest production cost found in this study is 2.53 and the average is 3.68 ETB/kg, this would give the farmers a negative result. The wholesalers are the ones who set the price and the farmers have to adapt to the market price in Addis Ababa.

Information from the farmers showed that there are no guidelines on how to grow onions. The use of fertilizers and pesticides varied widely among the farmers. The croplands were used differently, some of the farmers tried to get as high yearly yield as possible while some were afraid to get bad soil quality from too heavy utilization of the land.

Tax-regulations are not followed. All wholesalers should add VAT in the selling price and pay to the government. They are aware of it but only add VAT when a receipt is required. Three of nine wholesaler pay profit tax.

The knowledge from the study has been used to find suggestions on how reduce unnecessary losses and also how to increase the economic profit. The suggestions on how the chain might be improved are:

- Urge all chain actors not to mix bad onions with good onions to reduce unnecessary transportation of onions that only will be thrown away later and to avoid the spreading of diseases from bad to good quality onions

- Urge the chain actors to work for the best of the whole chain instead of the personal gain
- Develop a main organ to plan and control the flow of physical goods, information and money
- Ensure that the truck covering is sufficient enough during the rainy season to keep the onions dry while transported
- Take advantage of the value in the onion wastes by implement biogas production to the chain
- Educate farmers on how to most efficiently grow onions and how to use pesticides and fertilizers
- Follow tax-regulations to create a reliable and wholesome system that benefits the whole community

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Interviews

Farmers:
F1: In Koka between Meki and Ziway
F2: In Meki
F3: In Meki
F4: In Ziway
F5: In Ziway
F6: In Meki

Brokers:
B1: In Koka
B2: In Ziway
B3: In Ziway

Transporters:
T1: In Ziway
T2: In Ziway

Wholesalers:
W1: Atkilt Tera
W2: Atkilt Tera
W3: Atkilt Tera
W4: Atkilt Tera
W5: Atkilt Tera
W6: Atkilt Tera
W7: Atkilt Tera
W8: Atkilt Tera
W9: Atkilt Tera

Retailers:
R1: At Shiromeda market
R2: At Shiromeda road
R3: At Friends supermarket, Bole.
R4: At Novis supermarket, Bole.
R5: Next to Novis supermarket, Bole.
R6: At Sara minimarket, Kebena.
R7: At a small stand, Arat kilo.

Consumers:
C1: Shiromeda
C2: Bole
C3: Bole
C4: Bole
C5: Amist Kilo.
C6: Kebena.
C7: Arat kilo.
C8: Arat kilo.
C9:Kazan chis

Meki & Ziway onion production:
Meki & Ziway agricultural office, personal contact by Mr. Ashenafi Chaka, February 2014

Appendix A: Questionnaire, Farmer

Date of interview:
Name of the farmer:
Contact information:

1. Land use

a) What is the size of the farm and how much are used for onions?

b) Who owns the land?

c) How many harvests per year? Continuous sowing/harvesting all through the year independent of season?

d) What onion species does the farmer grow? Why this particular kind?

e) How many onion bulbs per hectare?

f) Does the quality of the onions change over the year? Rainy season?

g) Who buys the onions from the farmer? Where do the onions go? How much to each place?

2. Sowing

a) What is the reason for choosing a particular seed/seedling? Which are the desirable attributes?

3. Treatments

a) Are any fertilizers used? (Dap, Urea, other)

b) What kind of disease protection is used? (Mancozeb, Karate, Selekron, Ridomil, Profit)

c) How would the crops turn out if no insecticides where used?

d) Are there any negative consequences from using disease protection?

e) Is irrigation used?

f) How is the ploughing conducted?

4. Harvest

a) How are the onions packed when pulled from the soil?

b) Who owns the “packages”/”boxes”? How many are used for one harvest? Are they reused?

5. Post-harvest

a) In what are the onions packed for transportation? Who packs the onions?

b) Who owns the “packages”/”boxes”? How many are used for one transport? Are they reused?

c) Is there any storage at the farm for onions?

d) How are the onions transported? Who owns the transport?

e) How is the transport company/wholesaler chosen? Or do the buyers contact the farmer?

6. *Losses*

a) Are onions sorted away as worthless before selling? How much?

b) Who is it that determines if the onions should be thrown away?

c) What is done with the bad onions?

7. Information

a) How does the farmer get information about buyers/ transporters?

b) How does the farmer know what price to take for his onions?

c) Do different buyers pay different prices?

d) If a broker is used, does the farmer pay him/her? How do the broker and farmer find each other?

e) How does the farmer know how much onion to sow?

f) How does the farmer find sellers of fertilizers and disease protection? How does the farmer know what prices that are reasonable for the treatments?

g) How does the demand pattern look over the year? (Consistent, Seasonal, Random, Cyclic)

h) How does the farmer find workers?

i) Is there any cooperation between the onion farmers in the area?

Appendix B: Value chain questionnaire, Farmer

	Value chain questionnaire: Farmer
How big farm (ha)	
Onion species	
Yield (q/ha)	
Costs	
Machinery (birr)	
What kind from where?	
Oxen	
How many, cost, lifetime	
Irrigation (birr)	
How, how often, used for all crops?	
Seed/seedling	
From where, how much, how often	
Fertilizer Urea usage (q/ha)	
Fertilizer Urea cost (birr/q)	
From where, how much, how often	
Fertilizer DAP usage (q/ha)	
Fertilizer DAP cost (birr/q)	
From where, how much, how often	
Disease protection usage	
Disease protection cost	
From where, how much, how often	
Weed killer usage	
Weed killer cost	
Negotiating price?	

Labor	
Employment type	
Permanent (how many and type)	
Temporary (how many and type)	
Gender	
Land use	
Cost, rental, leasing, taxes	
Broker	
Cost	
Relation to broker	
Transport	
Cost	
Relation to transport	
Consultants	
Type	
Cost	
Service	
Type	
Cost	
Other	

Income	
Price (birr/kg)	
Average/latest/prediction of next	
How is the price determined	
Subsidies	
Type	
How much	
Buyers	
Type	
destination	
How much to each	
How was the irrigation carried out before pump	
Transportation of products to the farm	
How is the workers recruited?	
Are the workers trained for the work?	
Is accounting done?	
Plans to develop the farm?	
Cooperation with other farmers?	

Appendix C: Questionnaire Broker

Date of interview:
Name of broker:
Contact information:

1. General questions

a) What does a day at work look like? What tasks are included in the broker's work?

b) Where is the broker located?

c) Does the broker visit the farms in advance to determine the quality of the onions?

d) Does the amount of work vary over the year?

2. Economical

a) How much does the broker earn? How is the salary paid (Weekly, monthly, per amount of onions, as percentage of onions value)?

b) Who pays the broker?
c) Is the salary enough for making a living or does the broker has other jobs as well?

d) What are the broker's expanses, if any?

3. Information

a) How does the broker know which farmers/wholesalers to contact? Or do the farmers/wholesalers contact him/her?

b) Based on what does the broker choose farmers? (Price? Location? Friendliness? Other reason?)
c) Is the broker working with the same farmers for many harvests?

d) How many farmers is the broker working for?
e) How does the broker know which wholesalers to contact? Or do they contact him/her?

f) Does the broker work with the same wholesalers every day?
g) How many wholesalers is the broker working for?

h) Based on what does the broker choose wholesalers? (Price? Location? Friendliness? Other reason?)
i) Does the broker arrange with the transportation of the onions?

j) If so, how are the transportation companies selected? (Price? Food security? Reliability? Friendliness?)
k) Does the broker arrange with things to pack the onions in? (Plastic boxes? Wooden boxes? Bags? Other?)
l) If so, how are the "boxes" selected? (Price? Quality? Environmentally friendly?)
m) What is the cost of packaging? Who pays for them?
n) If the onions are bad, can the broker follow up on the quality to the farmer?

Appendix D: Questionnaire, Transport Company

Date of interview:
Name of interviewee:
Contact information:

1. General questions

a) What is the size of the transport company? Number of trucks, employees etc.

b) What kinds of trucks are used for the transportation of onions and how much onion can one truck carry?

c) Time for transport from Meki/Zewi to Addis?

d) To where in Addis are the onions delivered? Does the whole load of onions end up at the same place?

e) Are there any problems related to the traffic situation in Addis, e.g. traffic jam?

f) Do the trucks have any emission control system, for example a catalyst or particle filters?

g) What does the workload over the year look like? (Cyclic? Consistent? Trend? Random?)

h) Are there any difficulties to keep the onions fresh during transportation?

i) Are there any problems with onions falling of the truck and/or onions getting damaged by the pressure of other onions?

j) If the onion bulbs are damaged during the transportation, what is the most common cause?

k) Amount of losses due to damage during transportation?

l) Who is economically responsible for onions damaged during transportation?

m) What is done with the damaged onions?

2. Information

a) How do the wholesalers and transporters get in contact with each other?

b) How many wholesalers are the transport company dealing with? Is it usually the same wholesalers?

c) How do the transport company find farmers and how long in advance are plans made for one trip?

d) Who decides if the onion bulbs are too damaged to be sold?

e) Is there any broker involved at farmer- or wholesaler level?

f) What are the plans for the future for the transport company?

Appendix E: Value chain questionnaire, Transport Company

	Value chain questionnaire: Transportation
How big company	
Costs	
Truck	
Type	
Cost	
Life expectancy	
Buy from where	
Service costs	
Transportation	
Time for transport	
Fuel cost	
Labor	
Driver	
other	
Other	
Taxes	
Damage onions	
Income	
From who	
How much	
Contracts with farmers or wholesaler?	

Appendix F: Questionnaire, Wholesaler

Date of interview:
Name of interviewee:
Place: Contact information:

1. General questions

a) What onion-species? How often are onions bought and in what quantity?
b) Do you get to see samples of the onions before buying them?
c) Time for transport from Meki/Zewi to Addis?
d) To where in Addis are the onions delivered? Does the whole load of onions end up at the same place? Is it only onions on the truck?
e) Are there any problems related to the traffic situation in Addis, e.g. traffic jam?
f) What kind of costumers do you have? (Restaurants? Shops? People?)
g) About how much to each type of costumer?
h) What does the workload over the year look like? (Cyclic? Consistent? Trend? Random?)
i) Are there any storage possibilities for onions at the market? For how long?
j) What kinds of trucks are used for transportation and how much onion can one truck carry?
k) Are there any difficulties to keep the onions fresh during transportation?
l) If the onion bulbs are damaged during the transportation, what is the most common cause?

m) Amount of losses due to damage during transportation?

n) Who is economically responsible for onions damaged during transportation?

o) Are onions of lesser quality sold to a lower price? How much per week and to what price?

p) Amount of actual losses at the market per week? (Can for example be rotten onions, old onions, dry onion peel)

n) What is done with the wastes?

o) Is it ever a problem with purchasing too much or too little amount of onions? How often?

2. Information

a) How do the wholesaler find trucks for the onion transportation?

b) How many farmers is the wholesaler dealing with? Is it usually the same farmer every harvest?

c) Any contact with the farmers?

d) Who decides if the onion bulbs are too damaged to be sold?

e) How is the contact with the broker? Who contacts who?

f) If the onions are bad, can the wholesaler follow up on the quality? To whom?

g) How long in advance does the wholesaler plan with brokers/farmers/transporters to get onions to a certain day?

Appendix G: Value chain questionnaire, Wholesaler

	Value chain questionnaire: Wholesaler
How big company	
Costs	
Labor	
Employees	
type	
Cost	
Transport	
Trucks	
lifetime (km,year)	
driver	
fuel	
service	
From Meki	
Onions	
From where	
how much	
price	
quality	
Broker	
Farmers paid differently?	

Sales point	
Premises	
Taxes	
other	
plastic bags	
wooden boxes	
trips to farmer	
consultants	
Income	
Onions	
price	
Customers	
where	
how much to each type	
Sold per day/week/year	
Other products	
percentages	
Trucks use percentage	

Appendix H: Questionnaire, Retailer

Date of interview:
Name of interviewee:
Place:
Contact information:

1. General questions

a) Where do you buy onions for your stand/shop, how much and how often?

b) What onion-species do you sell and why have you chosen to sell this particular kind?

c) Do you get to see samples of the onions before buying them?

d) How are the onions transported to your stand/shop?

e) At what time of the day are the transports carried out?

f) Are there any problems with the transportation e.g. traffic jams?

g) Are there any onion losses during transportation?

h) What kind of costumers do you have? (Restaurants? Shops? Households?)

i) About how much to each type of costumer?

j) Are there any storage possibilities of onions at your stand/shop? If so, how long do you keep them stored?

k) Are there any onion losses (getting old, rotten, dry peel) at your stand/shop? If so, how much?

l) What is the reason for onions going bad?

m) If there are losses, what is done with them?

n) Is it ever a problem with purchasing too much or too little amount of onions? How often?

2. Information

a) How many wholesalers of onions are you dealing with? Is it usually the same?

b) How are the wholesalers chosen? (Based on price, location, quality, other?)

c) Who decides if the onion bulbs are too damaged to be sold?

d) Do you have any contact with a broker?

e) If the onions are bad, can the retailer follow up on the quality? To whom?

Appendix I: Value chain questionnaire, Retailer

	Value chain questionnaire: Retailer
How big company	
Costs	
Onions	
From where	
how much	
price	
quality	
Transport	
How	
by who	
price	
Labor	
employees	
type	
Cost	
Broker	
Yes/no, cost	
Sales point	
type	
rental	
from who	
other costs	

Premises	
Taxes	
other	
Income	
Onions	
price	
Customers	
where	
how much to each type	
Sold per day/week/year	
Other products	
percentages	

Appendix J: Questionnaire Consumers, Restaurants

Date of interview:
Name of interviewee:
Place:
Contact information:

1. General questions

a) From where do you buy onions and why do you buy onions from that certain place?

b) About how many kilograms of onions does your restaurant buy per week?

c) Is it hard to find onions?

d) Do you ever buy too much or too little amount of onions? How often and how much?

e) Do you have a contract with a specific retailer / wholesaler?

f) How do you store the onions at the restaurant? Refrigerated? In room temperature? On a shelf? Outside?

g) Roughly how much unused onion do you throw away every week?

h) What is the reason for onions going bad? Bad quality? Getting old? Insufficient storage? Vermin?

i) How are the onions transported from the wholesaler to the restaurant?

j) Do any onions go bad during transportation from the wholesaler to the restaurant?

k) What is done with the losses?

3. Economical

a) How much do you buy onions for?

b) How much do you pay for transportation of the onions?

4. Information

a) Who decides if the onion bulbs are too damaged to be used? Head chef?

b) How do you decide where to buy your onions? Based on price? Based on location? Other reason?

c) If the onions are bad, can the restaurant follow up on the quality? To whom?

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