



Sveriges lantbruksuniversitet  
**Fakulteten för veterinärmedicin och husdjursvetenskap**

Swedish University of Agricultural Sciences  
**Faculty of Veterinary Medicine and Animal Science**

## **Animal welfare in Ethiopia: Handling of cattle during transport and operations at Kera Abattoir, Addis Abeba**



**Antonia Grönvall**

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# Animal welfare in Ethiopia: Handling of cattle during transport and operations at Kera Abattoir, Addis Abeba

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## Abstract

The main objective of this study was to evaluate animal welfare situation in Ethiopia during slaughter and to investigate chain activities between animal markets and Kera abattoir in Addis Abeba. In total, 442 animals were observed within 52 groups of cattle; both ox and calves with different breeds. The study was divided into four different sets of data collection; behavioural observations, recording of slaughter process, observation during transport and interview. During the behavioural observations, an ethogram was used with 46 behaviours observed, categorised into 5 different groups. The data was calculated using Excel and SAS. The results indicated that a significant correlation ( $p$ -value $<5\%$ ) between abusive handling "beating of body" (frequency 46%) and aggressive animal behaviour "aggressiveness" (frequency 23%). In the supply chain, distance between Kera abattoir and the eight, most common markets, varied from  $<1$  km to  $>600$  km. To improve animal welfare and hence, Ethiopia's agricultural sector, further studies must be made, with more detailed measurements such as heart rate, glycogen and pH-value.

**Keywords:** Ethiopia, cattle, animal welfare, animal handling, animal behavior, slaughter, animal transport, supply chain

## Sammanfattning

Målet med den här studien var att undersöka dagens djurvälstånd på Kera abattoir i Addis Abeba, Etiopien. Målet var också att kartlägga transportkedjan av djur mellan slakteriet och djurmarknader runt om i Etiopien. Totalt observerades 442 djur, inom 52 grupper med både oxar och kalvar av olika raser. Undersökningen delades upp i fyra olika steg; beteendeobservationer, observation av slaktprocessen, observation av transport samt en intervju med en anställd på slakteriet. 46 olika beteenden observerades och delades in i fem olika grupper som definierades i ett ethogram och delades upp i fem olika grupper. Data beräknades sedan i Excel och SAS och resultaten visade signifikant korrelation ( $p$ -värde $<5\%$ ) mellan "beat of body" (46% frekvens) och "aggressiveness" (23% frekvens). I den kartlagda transportkedjan varierade avståndet mellan Kera abattoir och de åtta, vanligaste djurmarknaderna, mellan  $<1$  km till  $>600$  km. För att förbättra djurens välbefinnande, och därmed Etiopiens jordbrukssektor, måste ytterligare studier göras med detaljerade mätningar såsom hjärtfrekvens, glykogen och pH - värde.

**Nyckelord:** Etiopien, nötkreatur, djurskydd, djurhantering, djurens beteende, slakt, djurtransport, supply chain

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## 1. Introduction

Ethiopia is one of Africa's largest exporters of livestock animals and produced 19.32% of Africa's cattle production in 2011 (FAOSTAT, 2013). The national economy is one of the fastest growing in the world and 47% of GDP involve the agricultural sector (Rich et al., 2009). However, access to the global market is limited by the country's problems with animal disease, lack of hygiene and animal health. At the same time, the western countries request an increasing amount of meat available for import and demand a structured and clear supply chain with consistent quantity and quality (Rich et al., 2009). As meat is the main source of protein for humans, it should be clean and safe. However, the hygiene and animal welfare are today suffering because of a lack of knowledge and economic problems in developing countries. The transport of livestock animals for meat production in Ethiopia are currently mostly done by foot (trekking) or in best cases by vehicle, mostly during long distances (Gebremedhim, 2007). This results in long distance journeys with no sufficient food or water and minimal rest, factors that cause severe stress to the animals (Bulitta et al., 2012)

The World Organisation of Animal Health, OIE, together with the Farm Animal Welfare Council, FAWC, give recommendations on how to treat animals for livestock production. The Five Freedoms, stating that any animal kept by humans should be protected from unnecessary suffering, are backed by FAWC. However, Ethiopia has no guidelines or laws regarding animal welfare and has no or little knowledge about animal handling for food production.

The aim of this study was therefore, to evaluate the welfare situation of cattle at Addis Abeba Kera abattoir in Ethiopia. The aim was also to investigate and map the supply chain of cattle from markets to the abattoir in Addis Abeba.

## 2. Literature Review

The agricultural sector in Africa is wide and very important, both in the animal- and crop production. Ethiopia is one of the continent's largest meat exporters and was in 2011 estimated to provide with a total of 19.32% of Africa's cattle production. The country is located in the horn of Africa and has approximately 53 million cattle (FAOSTAT, 2013). Today, the agricultural sector estimates up to 47% of the national GDP and approximately 80% of the labour-force works within agriculture. At the same time, almost 40% of the population lives in poverty (WorldBank, 2013). The livestock sector is of national importance and the Ethiopian government has set goals to improve productivity in this sector (Halderman, 2004).

At the same time, the rising population offers a great potential for a higher livestock production in the African countries and the request of meat production from the western countries increases each year (Rich et al., 2009). Today, Ethiopia's earnings from export of livestock products are relatively low and Gebremedhim (2007) found, in previous studies, that the central problems were continued use of traditional technologies, a limited supply of food and water, unstructured animal breeding and high disease prevalence. For example, foot-and-mouth disease, *Aphthae epizooticae*, remains a major problem in Africa, an infectious disease that is already extinct in the developed countries of the western world (Rich et al., 2009). An improvement of hygiene in slaughterhouses and stricter animal welfare standards would mean easier access to the global market, which may result in a significant way out of the country's poverty.

The climate in Ethiopia varies a lot, from high temperatures up to 50°C in the Danakil Desert to periodic snowfall in the peaks of Bale. The capital, Addis Abeba, is located in the central part of Ethiopia at an altitude of 2,400 m. Due to its high altitude; the temperature is lower than in the desert and usually varies between 20-25°C. During the rainy seasons between mid-June and October, the heavy rain with an average of 110-280 mm cools down the temperature to an average of 15 °C (Briggs, 2012).

In Ethiopia, the breeds of cattle vary a lot but are usually mixed with Zebu (*Bos Indicus*) and Sanga (*Bos Taurus Africanus*) (DAGRIS, 2013), with the most popular breeds including Borana, Horro, Fogera, Arussi, Karayu and Nuer (IBC, 2004). The Zebu cattle is thought to origin from Africa more than 4000 years ago (Rege, 1999) and the Sanga cattle is believed to have evolved as a result of crossbreeding Longhorn- Shorthorn- and Zebu cattle, over 3000 years ago (Payne & Wilson, 1999). For all ruminants, including those of Zebu and Sanga, rumination is a natural behaviour (Trask & Sigmon, 1999). In Ethiopia, the cattle are mainly used for draught and milk production (Rege & Tawah, 1999).

## 2.1 Animal Welfare

No significant definition if animal welfare is yet stated, but three general criterias are used; the biological function, the affective state and the natural state (Mellor et al., 2009). The biological function means that animals that are healthy, growing and reproducing well, have good animal welfare (Barnett & Hemsworth, 2003). The affective state includes positive experiences versus the experience of suffer (Dawkins, 1998). Last, the natural state explains the animals' welfare as the extent to how an animal is able to express most of its natural behaviours (Alroe et al., 2001).

The welfare of an animal includes both its physical and mental state and according to the Farm Animal Welfare Council (FAWC, 2013) any animal kept by humans should be protected from unnecessary suffering. According to the Five Freedoms, the animal's welfare is considered as:

1. Freedom from Hunger and Thirst - by ready access to fresh water and a diet to maintain full health and vigour;
2. Freedom from Discomfort - by providing an appropriate environment including shelter and a comfortable resting area;
3. Freedom from Pain, Injury or Disease - by prevention or rapid diagnosis and treatment;
4. Freedom to Express Normal Behaviour - by providing sufficient space, proper facilities and company of the animal's own kind;
5. Freedom from Fear and Distress - by ensuring conditions and treatment which avoid mental suffering.

Furthermore, the World Trade Organisation, OIE, gives, recommendations on how to treat live domesticated animals in their Terrestrial Animal Health Code (OIE, 2012). According to article 7.5.2, "*animals should be handled in such a way as to avoid harm, distress or injury. Under no circumstances should animal handlers resort to violent acts to move animals, such as crushing or breaking tails of animals, grasping their eyes or pulling them by the ears.*" Further on they make specifications on the conditions of lairage and state that animals kept in outdoor lairage should be given shelter from adverse weather conditions. Ethiopia is not a member of OIE yet, but has applied for membership in 2003. The Working Party met for the



third time in March 2012 to continue the examination of Ethiopia's foreign trade regime. A WTO membership could contribute to the fight against poverty, since trade is a proven engine for economic development.

When evaluating animal welfare, behavioural measurements are among the preferred methods, since the animals behave in response to the new environment (Broom, 2007). Furthermore, physiological responses such as hormones can be indicators used when studying animal welfare. It is also important to separate the different factors of expressed animal behaviours; fearful animals may be easy to move while animals fearful of humans are likely to be the most difficult to handle (Hemsworth, 2007).

In developing countries like Ethiopia, long-distance journeys, forcing animals to cross big rivers that have no bridge and journeys without sufficient food, water and resting time cause stress to animals. Furthermore, the animals are exposed to high temperatures and heavy rain, both during transport and in lairage (Bulitta et al., 2012). The stakeholders during transport, at markets and in abattoirs are usually not educated for their job and have no or less sufficient knowledge and understanding about the welfare of animals. In general, poor animal welfare results in loss of weight, physical injuries, sickness and sometimes even death of animals.

## **2.2 Slaughter of animals**

As meat is the main source of protein to humans, it should be clean and free from diseases. Previous studies by (Jibat et al., 2008) found that there was a significantly high amount of rejected carcasses at HELMEX abattoir, Debra Zeit. Out of 2688 sheep and goats, 50.1% livers and 42.9% lungs were prohibited from international markets major due to parasites and pneumonia. The main factors causing this were animals transported on foot with no or less food/water and in open, overcrowded vehicles. Another study, done by Woube (2008) resulted in 76.8% of livers and 61.6% of lungs rejected, mostly due to parasites and damage during slaughter. According to The World Organisation of Animal Health, OIE, the veterinary service of the exporting country has ultimate responsibility for certification of slaughtered animals (Thomson et al., 2004). However, the process of this is still a worldwide problem, which is particularly critical within developing countries.

If the animals are stressed before and/or during slaughter, it affects not only animal welfare but can also give non-wanted consequences on the meat quality (Gregory et al., 2010). As early as 1944, Hall et al. (1944) found that an elevated pH of dark-cutting meat was directly related to a deficiency of muscle glycogen before slaughter. Dark-cutting meat is a quality defect characterized by raised pH, high water-holding capacity, and a dark-red, dry, firm and sticky texture to the lean muscle. It occurs if the animal is handled under poor animal welfare conditions before slaughter. The concentration of glycogen varies greatly at the time of slaughter depending on the muscle, species and nutritional status of the animal, but most of all on the level of pre-slaughter stress (Immonen et al., 2000). In previous studies dark-cutting meat are used as indicators for duration of restraint and isolation stress, during for example long-term and short-term transportation, animal handling and food withdrawal. (Apple et al., 2005).

In Ethiopia, most of the cattle are slaughtered without stunning, not only due to religious reasons, but also because of continued traditions and lack of further knowledge about modern slaughter techniques. When cattle are slaughtered without stunning some animals may take several minutes before they lose brain function and die. The delay can be a combination of many factors, such as false aneurysms in the severed carotid arteries and sustained blood flow

to the brain (Blackmore, 1984) and previous studies have shown that 8% of cattle slaughtered without stunning can develop false aneurysms in the carotid arteries (Holleben, 2007). Aspiration of blood into the upper respiratory tract and lungs can also cause suffering during slaughter without stunning (Gregory et al., 2010).

Furthermore, OIE (2012) states, in their article 7.5.9, international recommendations for slaughter of animals. To reduce the risk of possible failure when cutting both carotid arteries and hence causing severe pain during and after cut, the OIE recommends the abattoirs to have personal with high level of competency and who are supplied a very sharp knife of sufficient length.

During slaughter, bad hygiene or the wrong techniques can mean severe consequences to the meat quality. For example, the step where the carcass is divided into two is a stage during the slaughter of high risk. As soon as the bone marrow is touched, the risk of spreading the infectious disease Bovine Spongiform Encephalopathy, BSE, is very high (Helps et al., 2002). Furthermore, the hygiene during slaughter is of high importance and dirt and soil are the primary sources of contamination of carcasses (FAO, 2013).

Right now there is no substantial knowledge in Ethiopia regarding animal welfare and hygiene in slaughterhouses and there are no explicit rules and regulations on how animal handling in slaughterhouses should be done (Rich et al., 2009). The issue concerning the regulation of animal welfare is being discussed more and more internationally (Thomson, et al., 2004) (Scoones & Wolmer, 2008) but it requires a broader range of scientific studies in order to implement a legislative change. In order to secure greater market access in other countries more extensive studies on animal welfare need to be carried out and stricter requirements on hygiene in animal handling and slaughter are needed.

### **2.3 Animal transport**

In developing countries the transport of animals are mainly by foot, or by ordinary vehicles not designed for animal transport (Kenny & Tarrant, 1987). Almost all livestock in Ethiopia are transported by people on foot (Gebremedhim, 2007). In rare cases during longer distances vehicles are used, but usually not preferred since trekking is cheaper than transporting the animals with vehicles. It can vary as much as between 16 ETB/animal for trekking or 60-80 ETB/animal for vehicles for a distance of 200 km (Gebremedhim, 2007). However, traders prefer the vehicles, to avoid weight loss and declined body condition. In a previous study (Bulitta et al., 2012) 318 cattle were followed and observed during trekking from Gudar Market to Addis Abeba. Of these, 16% died with 7.1% due to car accidents and the rest from lack of water and food, bad condition and/or injuries.

The education of the stakeholders during transport is varied and licence is only required in some areas of Ethiopia (Gebremedhim, 2007). In Tigray, Oromia and SNNPR no license is needed for transport of animals and the reasons given for the absence include the difficulty to control the trading business as the traders are mobile from place to place. Gebremedhim (2007) found that stakeholders asked for better infrastructure in livestock production with improved food and water supply, better market information and developed supply chains between farmers and markets.

In previous studies, Aradom (2012), have shown the importance of using proper transport vehicles for animal transport. The vehicles should be equipped with necessary devises to improve animal welfare. Aradom also states the beneficial consequences of reducing transport time and distance; not only as an economic aspect but also in an animal welfare perspective. Below is a figure made by Aradom (Figure 1), illustrating the animal behaviour and condition during transportation. Stress including factors, such as transport time and road condition, are included together with measured responses and the possible end product. In the stress factors, both behavioural and physiological changes are included, based on a previous study made by (Broom, 2000). Using these factors and measurements, animal welfare and meat quality can be studies during animal transports (Aradom, Animal Transport and Welfare with special emphasis on Transport Time and Vibration including Logistics Chain and Abattoir operations, 2012).

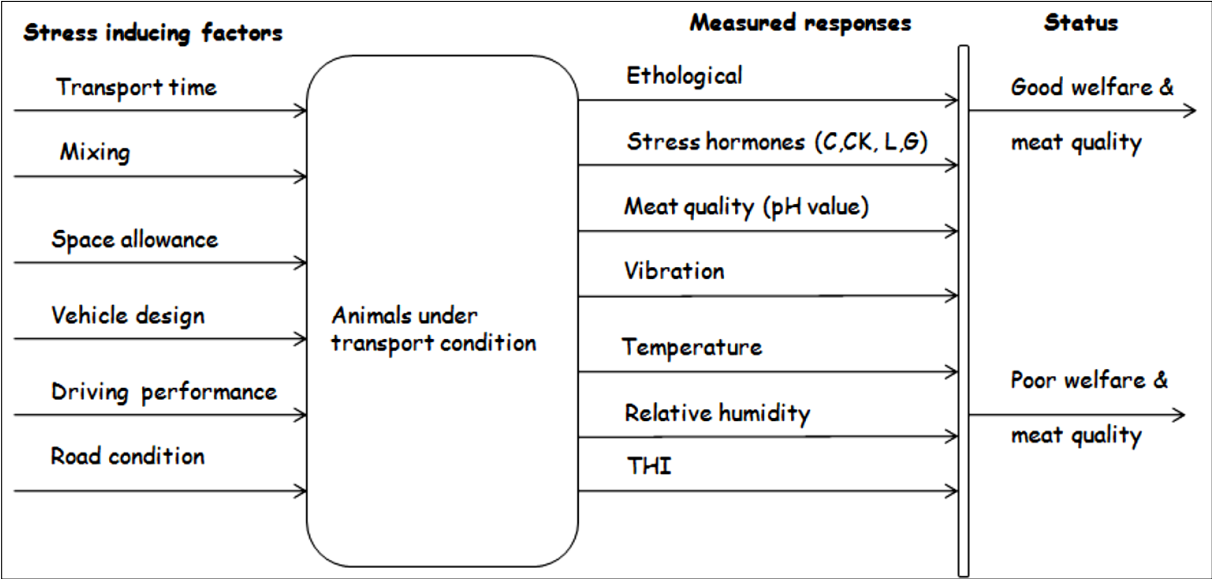


Figure 1: Stress inducing factors and stress responses during animal transport (Aradom, 2012).

The climate may also influence the animal behaviour during transportation, where high temperature in a vehicle can be a leading cause of poor animal welfare (Warris & Brown, 1994).

### **3. Objectives**

The main objective of this study was to evaluate the welfare of cattle at Addis Abeba Kera abattoir in Ethiopia. Furthermore, the transport of the cattle to the abattoir was examined. The specific objectives were to:

1. observe the animal handling and animal welfare situation in the lairage at the abattoir,
2. examine the slaughter process,
3. observe the animal handling before and during slaughter, and to
4. map out the supply chain of cattle from markets to the abattoir.

To achieve these objectives, four research questions were defined:

1. Which behaviours were frequently observed in the lairage?
2. Are there any correlations between abusive handling by the stakeholders and the frequently observed animal behaviours?
3. How are the animals slaughtered?
4. From where do the animals come from and how are they transported?

## 4. Materials and Methods

In Sweden, a pre-study was done for three weeks, to search for background literature and outlining a behavioural survey. A local abattoir was also visited, where Swedish slaughter methods and animal handling at the slaughter house was observed and documented.

### 4.1 Study area

The study was done in Addis Abeba, Ethiopia (see Figure 2a), for approximately 12 weeks between April 2012 and June 2012. During this time, the weather varied a lot between sun and high temperature to the rainy season in June with heavy rain and cooler temperatures. Two students, together with local guides were included in the study. Addis Abeba Kera abattoir, located around 100 meters from Kera market (see Figure 2b) and built in 1950, was the only abattoir in the capital and the decision of study area was therefore easy made. The abattoir slaughtered approximately 1200 animals per day (including cattle, sheep and goat) and had about 800 male employees involved in the slaughter process.



Figure 2a: Map over Ethiopia and Addis Abeba. Figure 2b: Map over Addis Abeba and Kera abattoir.

The abattoir included a lairage area, divided into 12 smaller components approximately  $12.5 \times 4.5 \text{ m}^2$ /each. There was also one minor zone for sick and injured animals, around  $6 \times 3 \text{ m}^2$ . The ground consisted of stone, gravel and sand and the fence was made of steel bars combined with masonry walls, about 1.5 meters tall (see Figure 3 below). Each lairage took 5-30 animals, depending on the time before slaughter and the total number of animals in the lairage. One visit with the transportation vehicle to Kara-Alo market was also done, to observe the transportation system between markets and abattoir.



Figure 3: photo of the lairage at Kera abattoir seen from above

## 4.2 Animals

The observed animals were cattle; both oxen and calves, with different breeds usually mixed together with the African cattle Zebu and Zebu (see Figure 4). Cattle are, along with sheep and goats, the most common animals at the markets and abattoir; however sheep and goats are not included in this study. The total number of animals observed in the study was 442 cattle, included in 52 groups. The ages of the observed animals varied among adults, with only two calves observed in the lairage (<1 year old).



Figure 4: photo of some crossbreed Zebu cattle in Ethiopia

## 4.3 Data collection

The data collection consisted of four different parts: ethological observations in lairage, recording of slaughter process, observation during transport and an interview with one employee at Kera abattoir.

### 4.3.1 Behavioural observations

In the lairage, an ethogram with definitions of the behaviours (Appendix 2) was defined using literature (Aradom et al., 2012) and adjusted after a two day pilot study during the first week. See Table 1 for definitions of the 10 most observed behaviours. 46 behaviours were observed, both human and animal behaviour, and categorised by the observer into five different groups; natural behaviours, abusive handling, aggressive behaviours, stress-related behaviours and resistance behaviours. Using a behavioural survey (Appendix 1), the animals and the stakeholders were observed by two students standing on a platform above the lairage. Each group of animals consisted of 4-17 animals, in average 9 animals per group. The animals were randomly selected and observed using instantaneous sampling, with a 6 minute interval and the animal behaviours were recorded as a frequency. The behavioural survey included documentation of date, breed, animal condition and number of animals in the group. Each group also got a survey number when observed in the lairage. Furthermore both a video camera and a photo camera were used to document the activity for later analyses.

*Table 1: Definitions of most observed behaviours*

<b>Behaviour</b>	<b>Definition</b>
Beating of body	The stakeholder is beating the animal with an object, ex stick, against the head
Beating of head	The stakeholder is beating the animal with an object, ex stick, against the body
Aggressiveness	The animal is showing aggressive behaviour with is ears pinned back, eyes wide open and/or is snapping in the air
Fighting	The animal is attacking other animals
Watching around	The animal is watching from side to side for observing the environment
Mounting	The animal is mounting other animals
Ear Erecting	The animal's ears are erected
Panting	The animal is breathing rapid and is gasping for air
Vocalisation 1	The animals are communicating with each other without being stressed or due to panic
Tail pulling	The stakeholder is pulling the tail in order to make the animal move

#### **4.3.2 Recording of slaughter process**

During slaughter, the animals and butchers were observed and documented by constant video camera recording. Two observers were monitoring the animal behaviour, the employees' work and the slaughter process. The slaughter process was also observed and documented step by step.

#### **4.3.3 Observation during transport of animals**

The transportation of the animals to Kera abattoir was registered by information from the head department at the abattoir. The origin and distance from where the animals usually came from was documented. One visit to Kara-Alo market was also done, including going in the transport vehicle together with two employees from Kera abattoir. The process with loading of animals at the market and unloading of animals at the abattoir was observed and registered. This was documented using both camera and video camera.

#### **4.3.4 Interview**

Furthermore, one of the employees in the head department of Kera abattoir was interviewed for approximately 30 minutes using an interview form, outlined in advance (Appendix 3). The main purpose of the interview was to get further information about the abattoir and the slaughter process.

### **4.4 Statistical analysis**

Data collected during ethological observations were entered and summarised into Excel spreadsheet. Occurrence of expressed behaviours was calculated by dividing the number of animals expressing behaviour by total number of animals examined, to get the percentages (%). Means were then calculated and used for describing the frequency of expressed behaviours in the lairage, which then were used for further calculations and analyses.

By using the frequency, data was tested for linear correlations and showed not to be normally distributed. To be able to use the data for further calculations, the values had to be manipulated to 0- and 1-values; when behaviours expressed=1 and when behaviours not expressed=0. The manipulated data was then entered into SAS 9.3 for calculating Kendall's tau-b correlation coefficient ( $\tau$ ) with the significant level set to 5% (p-value < 0.05). Abusive handling by humans was correlated with animal behaviours.

## 5. Results

### 5.1 Behavioural observations

Appendix 4 shows the total mean values of all 46 observed behaviours, with 8 behaviours expressed at a level  $\geq 10\%$ . In the lairage, injuries and lameness were also observed and documented. Out of 442 animals, 7% were observed to be lame.

#### 5.1.1 Frequency of behaviours

The frequency of expressed behaviours in the lairage was calculated and the means were then plotted in linear diagrams and then categorised into five different groups: natural behaviours, abusive handling, aggressive behaviours, stress-related behaviours and resistance behaviours.

In the lairage the cattle expressed natural behaviours and “watching around” was the most significant observed behaviour, with a frequency of 20% (Figure 5). The animals also expressed the behaviours “ear erect” at an incidence of 13%, “vocalisation 1” at 9% and “moving forward 1” at 8%. However, the natural behaviour “ruminating” was only observed at 3% in the lairage.

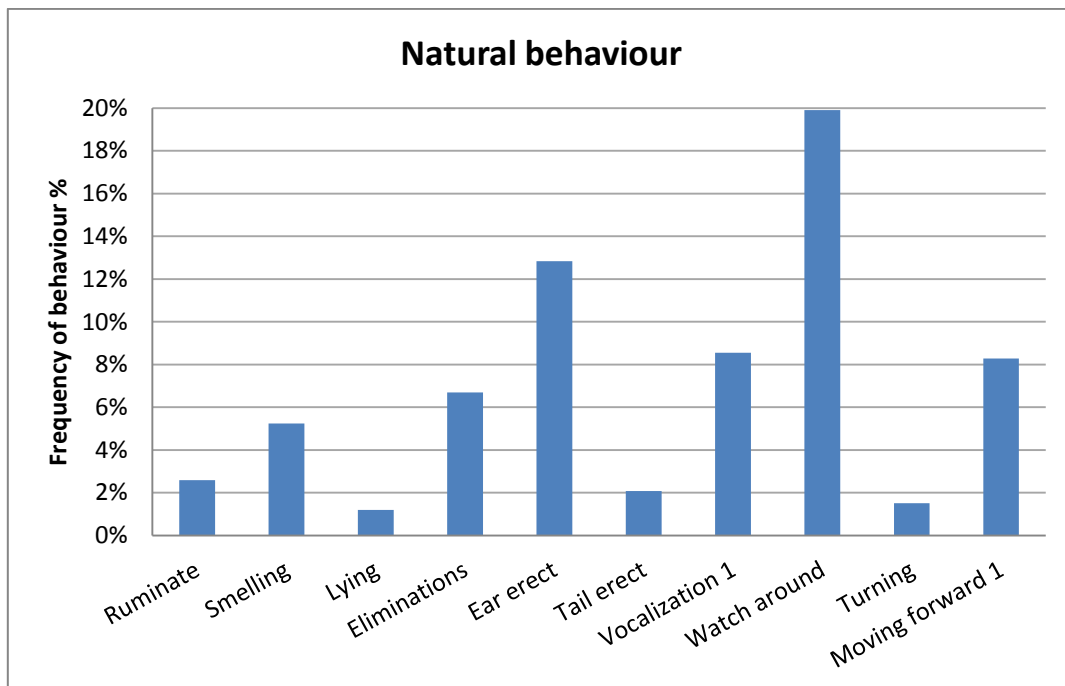


Figure 5: Frequency of natural behaviours expressed by animals in lairage.

The handling of animals by the stakeholders in the lairage was also observed and documented in the survey. The most frequent behaviours expressed by humans were “beating of the body” at a frequency of 46% and “beating of the head” with a frequency of 34% (Figure 6). These two behaviours were observed at significantly high levels and differ from the rest of the abusive handling behaviours in observed occurrence. The third most observed abusive behaviour is “tail pulling,” but is yet only expressed 10% and therefore differs 24% from “beating of the head”.



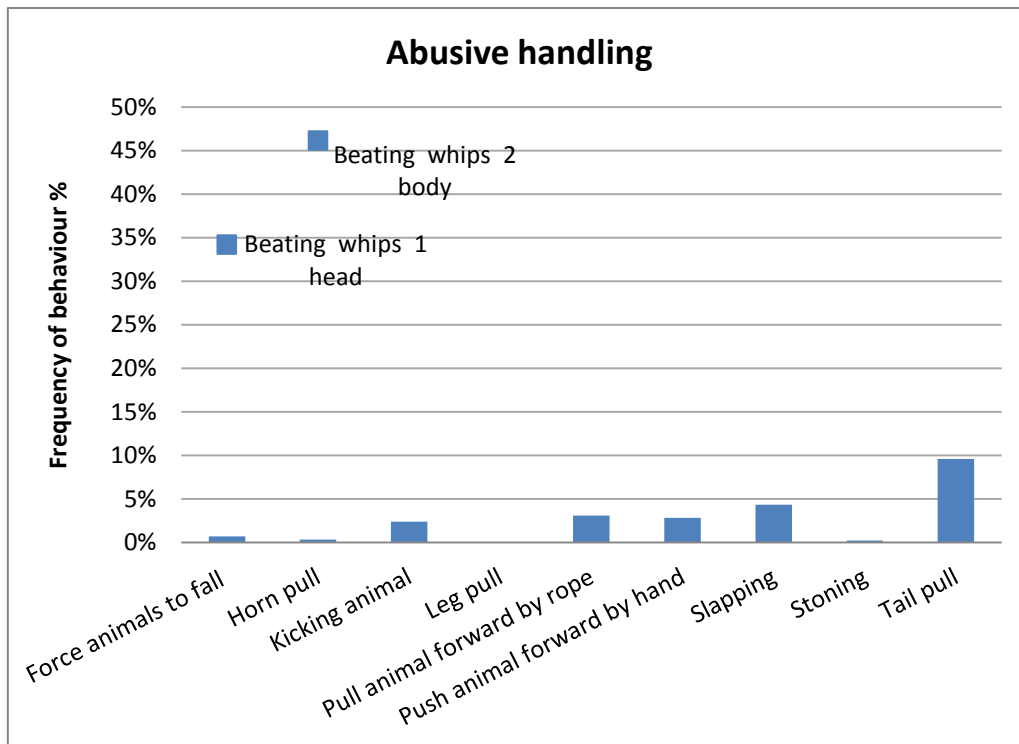


Figure 6: Frequency of abusive handling of animals in lairage.

The most frequently expressed aggressive behaviours were “aggressiveness,” “fighting” and “mounting” with occurrences around 20-23% (Figure 7). The animals were observed expressing “running” for 3% but never as “kicking” or “jumping”.

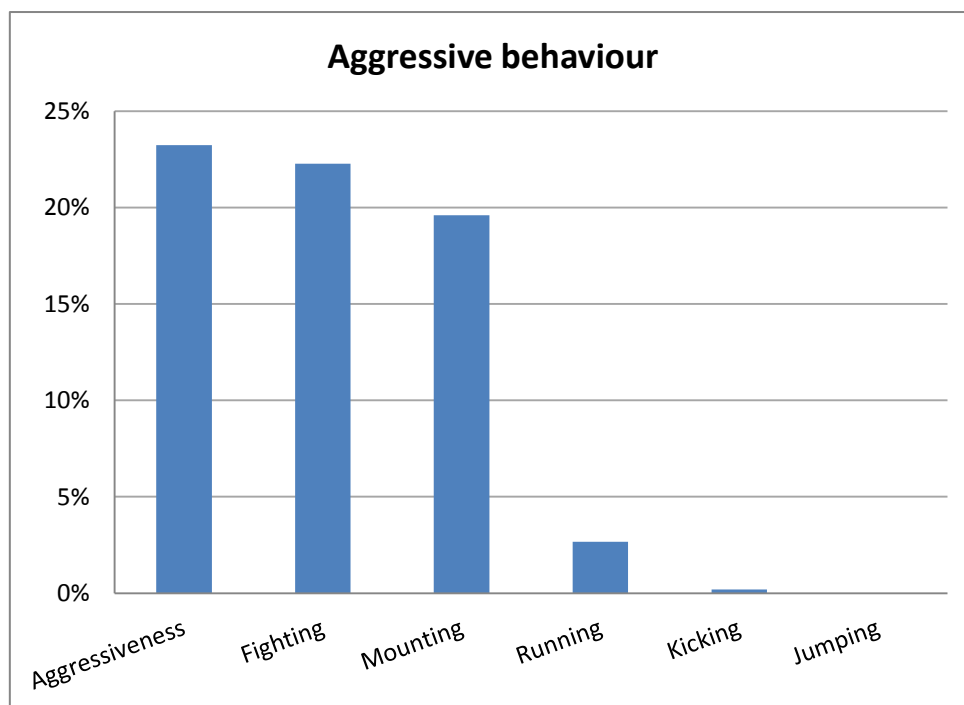


Figure 7: Frequency of aggressive behaviours expressed by animals in lairage.

Of the stress-related behaviours, “panting” (10%), “moving forward 2” (8%), “vocalising 2” (6%) and “head swinging” (6%) were the most frequently observed behaviours in the lairage.

The behaviours “paralyzed respiration” and “stamping of feet” were never seen and “idling”, “foaming” and “stretching” were expressed at less than 2% (see Figure 8 below).

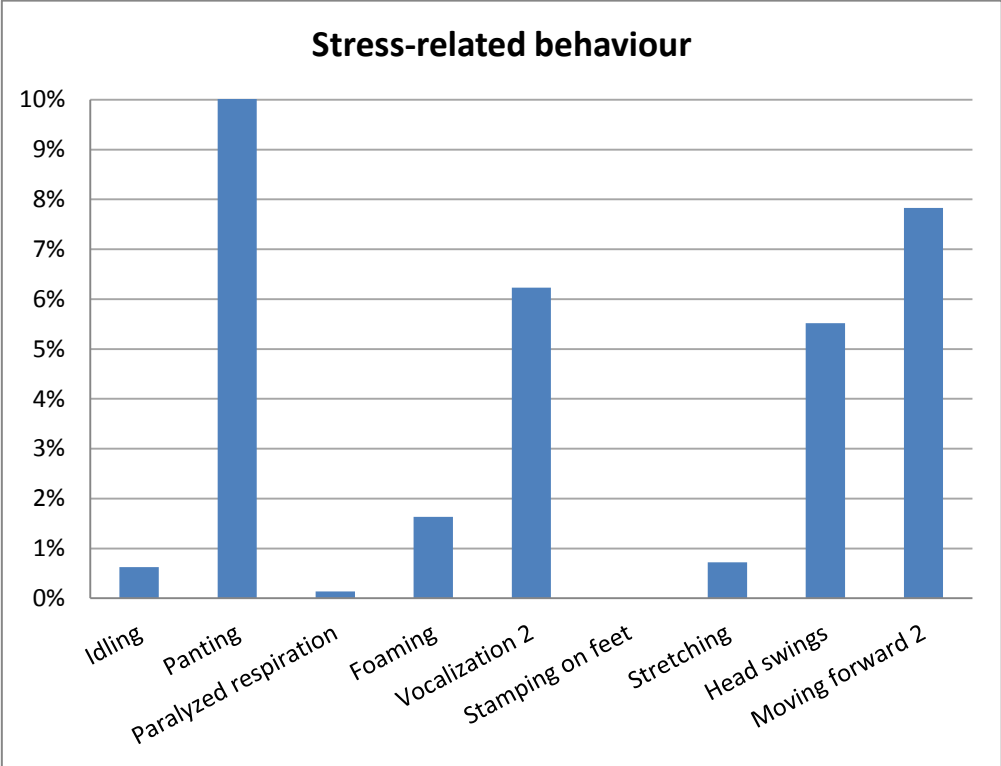


Figure 8: Frequency of stress-related behaviours expressed by animals in lairage.

Within the resistance behaviour-group, only one behaviour was significantly expressed; “slips slightly”, of 8% (Figure 9). “Balking” and “charging at stakeholders” were never seen and “falls” were only recorded at 1%.

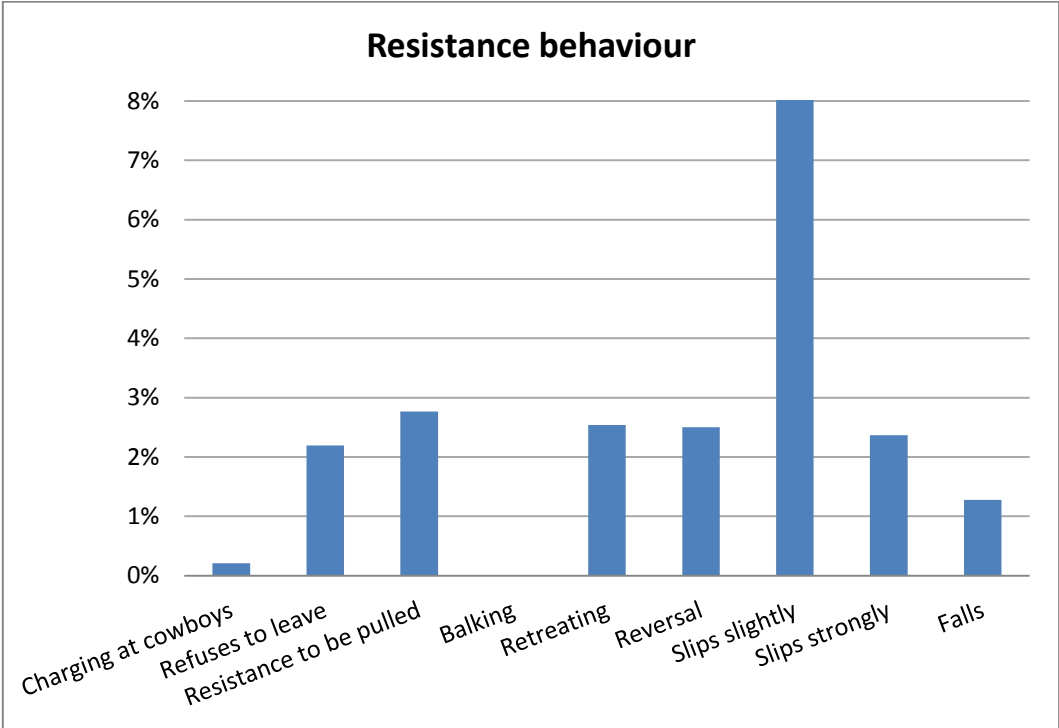


Figure 9: Frequency of resistance behaviours expressed by animals in lairage.

### 5.1.2 Kendall's tau-b correlation coefficient

Using Kendall's tau-b correlation coefficient abusive handling behaviours by humans were correlated with some of the animal behaviours within the categories aggressiveness, stress-related and resistance (see Appendix 5). Six pairs were significant correlated and are shown below (Table 2).

Table 2: Significant correlations within Kendall's tau-b correlation coefficients

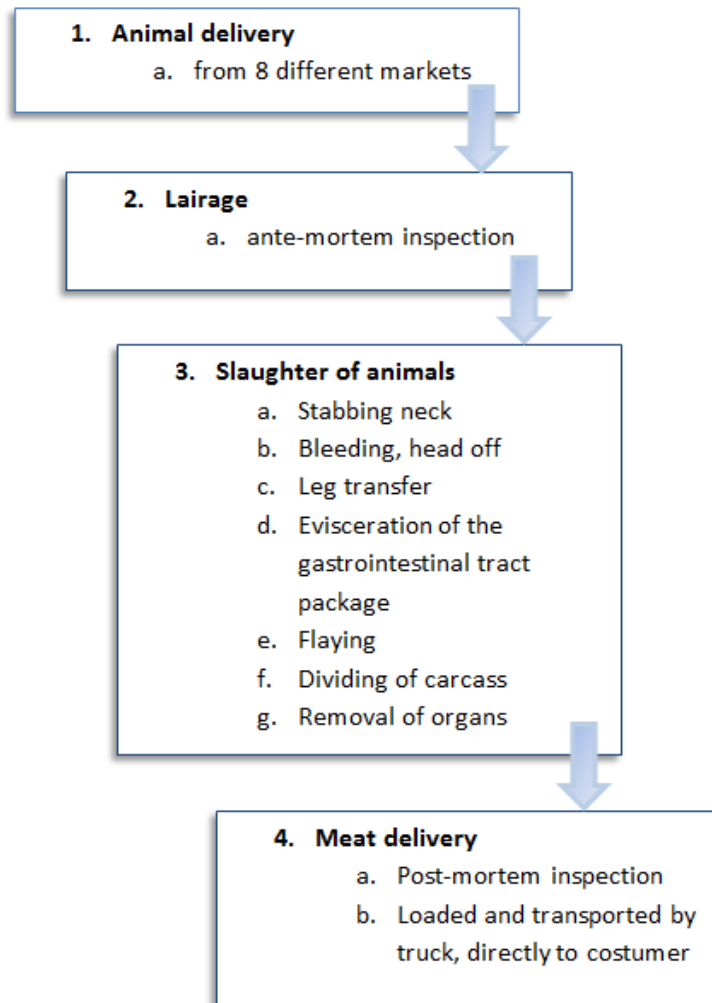
Abusive handling	Behaviour	$\tau$	p-value
Beating body	Aggressiveness	-0.287	0.040
Pulling by rope	Fighting	0.349	0.013
Pushing by hand	Charging at stakeholder	0.306	0.029
Slapping	Vocalization 2	0.260	0.063
Kicking the animal	Charging at stakeholder	0.388	0.006
Tail pulling	Panting	0.281	0.045

## 5.2 Slaughter process

The slaughter process was observed and documented; see Figure 10 for an overview of the activities. The animals were delivered to the lairage, between 11.00-16.00, from eight markets around and outside Addis Abeba. In the lairage, no shelter was provided from sun or heavy rain and the food and water supply was depending on the customer's request, but was usually not distributed. The animals never stayed overnight, but could be observed waiting in the lairage up to 11 hours. Before slaughter, the animals were also inspected by a veterinarian and animals showing any symptoms of infectious diseases were not slaughtered.

After the ante-mortem inspection, the slaughter activities started at 16.00. In average, 15 cattle were slaughtered at the same time, by approximately four people per animal. The animals were first collected in a smaller zone; an open area with only metal fences, approximately 10 m<sup>2</sup> big. In the "waiting area", the animals stayed for maximum three minutes, before they were taken into the slaughter hall for slaughtering.

The slaughter hall was a big, open area with wet and slippery floor that the animals easily slipped on when they were showing resistance behaviours and refused to move (Figure 11). During slaughter, no stunning was done but the animals were directly stabbed in the neck, to make them fall to the ground. During the observations, the butcher was witnessed to miss several times when performing this stabbing procedure and the eye reflex of the animal was observed during each stab. When the animal was laying on the ground, still conscious, the butcher bended the head back and was cutting of the head using a knife. The animal was then bleeding for several minutes, still lying on the floor; with water constantly streaming around and directly at the carcass. When the blood flow stopped, the legs were removed and the carcass was hanged in the hind limbs. Then, the gastrointestinal tracts and skin were removed and the carcass was divided by an axe into two. Finally, the organs were removed and inspected together with the carcass, by a veterinarian and two meat inspectors. The accepted meat was then loaded and transported by vehicle, directly to the customers with no refrigerating or cooling before.



*Figure 10: Slaughter process.*



*Figure 11: photo of the slaughter process.*

During the recording of the slaughter process, carcass and meat quality was also observed. At the body, large amounts of bruises could be detected as darker areas with clotted blood on the carcass. The bruises were mostly detected in the back areas, around the upper back and on the hind limbs. The head and legs were separated from the carcass and could not be inspected. The meat was not examined further and no pH-value was recorded.

### 5.3 Transportation of animals

Based on information from the head department at Kera abattoir, a supply chain between Kera abattoir and the supply markets was estimated and mapped (Table 3). To the abattoir, eight markets were main suppliers; four from Addis Abeba (Figure 13) and four outside the capital (Figure 12). One study visit was made to Kara-Alo market, where two students joined three butchers in the vehicle from Kera abattoir. At market, 20 animals were selected and loaded. The transportation vehicle had no roof, a slippery floor and walls made of steel approximately 2 meters high. Hence, the vehicle was not proper for animal transportation and the animals had no space to move. The stakeholders were pushing animals onto vehicle, using only man power and the force of closing gate (Figure 14).



Figure 12: Map of Ethiopia with market 6-10 (see Table 3).

Table 3: The ten most common animal markets supplying cattle to Kera abattoir  
\*Highland area not marked on Figure 12

Outside of Addis	Km
6. Harar	600
7. Jimma	450
8. Highland area*	150
9. Wellayta (Soddo)	200
10. Borena	>600
In Addis	
1. Kara-Alo	18
2. Addisu Gebeya	12
3. Kera	1
4. Birchiko Fabric	12
5. Akaki	25

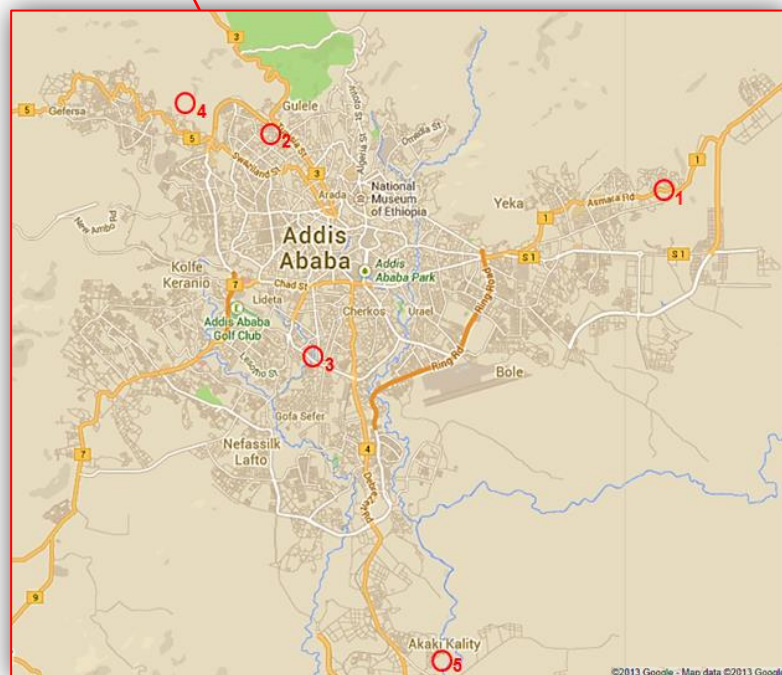


Figure 13: Map over Addis Abeba with market 1-5 (see Table 3).



*Figure 14: photo of the slaughter process.*

#### **5.4 Interview**

The interviewed employee has worked at Kera abattoir for nearly 28 years and had a Bachelor degree in Management, together with diplomas in Animal Health and Meat Technology. He worked in the head department and was responsible for the slaughter process at Kera abattoir. The employee explained how the animals were transported by vehicle from eight different markets, usually with around 10-20 animals per vehicle, depending on origin and transport duration. The exception was Kera Market, from where all animals were transported by foot, since the market was placed less than one kilometre from Kera abattoir. According to the employee, animals could get injured and in worst case die during transport, due to poor handling but more common because of bad body condition. He claimed the lack of suitable vehicles for animal transport and defined the present vehicles as built for other purposes rather than animal transport.

In the lairage, all animals were inspected by two veterinarians and injured animals, or animals suspected to have diseases, were not allowed to be slaughtered. The animals usually stayed for 8-12 hours, but never overnight. Food and water was provided for the animals depending on the customer's request, however, no shelter from weather conditions was provided. The employee told that injuries and death was not common inside the lairage and if it occurred it was mainly during dry season when animals could be in very poor body condition. The animals slaughtered were mainly adult cattle, but also some male calves and horses.

The main problem at Kera abattoir, according to the interviewed employee, was the absence of reaching up to international standards. Due to lack of educated man power and modern live animal markets, international standards could not be reached and export of meat was therefore limited.

## 6. Discussion

In the project, four specific research questions were defined:

1. Which behaviours were frequently observed in the lairage?
2. Are there any correlations between abusive handling by the stakeholders and the frequently observed animal behaviours?
3. How are the animals slaughtered?
4. From where do the animals come from and how are they transported?

Poor animal welfare was detected; mainly due to lack of education. Correlation between abusive handling by stakeholders and aggressive and stressed animals was detected several times. Furthermore, cattle were not expressing natural behaviours such as ruminating. Injuries in lairage were observed to be 7% out of 442 animals, mainly due to abusive handling by humans. However, there is a vague difference between animal behaviours expressed due to abusive handling and animal behaviours expressed due to other factors. For further studies in animal welfare at abattoirs in Ethiopia, the heart rate and glycogen should be measured. By using these measurements, the animal behaviours could be further investigated and additional conclusions could be completed. The behavioural observations can also be improved by separate different animal groups more and increase the background information about the animals. By reducing the observed animals and specify the characteristics of interest, focal sampling could be used and more detailed data could be obtained.

During observations in this study, animal welfare and handling of animals at Kera abattoir was observed. Several difficulties were found; especially in behavioural observations. First of all, it was hard to separate the different animal groups that were chosen to be observed. The animals were moving around in the lairage and all animals could not be seen all the time, which can be a possible source of error in the behavioural observations. Since the observations were done by standing above the lairage, some angles of the animal were not shown, and another possible source of error could be that all expressed behaviours were not seen. However, to be standing above ground when observing the animals was mainly due to safety reasons for the observers. When moving around down in the lairage, the risk of being injured by an animal was high. The climate during the observation could also be affecting the animal behaviour and the animal handling by the stakeholders. During the observations, the weather varied from sun and heat to heavy rain. During the sunny periods, the animals were moving around and were expressing a large number of behaviours; meanwhile during heavy rain the animals were calm and didn't move more than necessary. The rain also made the ground and stones more slippery and the possibility for animals to slip or fall was higher than during sunny days.

To obtain the international standard regulations and be able to export the meat to western countries, animal welfare needs to be improved. Possible solutions for animal welfare problems can be to establish regulations for animal welfare in Ethiopia and develop the education of animal welfare by stakeholders and butchers working with the cattle. During the slaughter of cattle, the process should be further investigated; both in the aspect of animal welfare, hygiene and health risks of polluted meat. Ethiopia's agricultural sector is one of the major sources to the national economy (Halderman, 2004) and by improving the livestock of animals, the poverty in the country can be reduced.

## **6.1 Behavioural observations**

### **6.1.1 Frequencies of behaviours**

Out of the 46 behaviours that were observed, 8 behaviours were expressed at a level of  $\geq 10\%$  of frequency. The most repeatedly expressed behaviours were “beating of head” at 46% and “beating of body” at 34%. The possible answer to why beating of animals was so repeatedly expressed can be the fact that it is the easiest way to escape animals and make them move.

By looking at the different categories of observed behaviours, the frequency of behaviours can be easier discussed. Among the natural behaviours, “watching around” and “ear erecting” were the most frequently expressed behaviours. Animals watching around and performing ear erecting indicate that the animals were frequently observing the environment. This can be explained as a possible consequence of constant activity in the lairage; new animals were frequently arriving and the stakeholders were moving around a lot. The fact that the animals were not ruminating more than 3% is not normal. Rumination is a natural behaviour for cattle and other ruminants (Trask & Sigmon, 1999) and the absence of this can depend on the limited supply of food and/or also due to stress during transport and in lairage. In the group of aggressive behaviours, “aggressiveness”, “mounting” and “fighting” were the most frequently expressed behaviours. Furthermore, “panting” was the most frequent observed behaviour; a behaviour usually expressed when animals are feeling stressed. Among the group with resistance behaviours, “slips slightly” was the most frequent behaviour. This behaviour is although an indirect consequence of animal resistance and is hence correlated to “reversal” and “resistance to be pulled”. One explanation to why the animals are showing resistance can be the fact that they are in a new environment, in a new group of animals and therefore feel stress. The stakeholders and butchers handling the animals are probably new to them and may not handle the animals as they are used to. The background of the animals is not known, but can vary a lot and so can the previous animal handling. Some of the animals may be used to humans and handling by humans, meanwhile others can have no or very little experience of humans. It is also important to count the variation of the butchers and stakeholders; with different backgrounds in animal handling and previous education. It is also important to take into account the big variation within number of animals in the different groups; the number varied from 4-17 animals. The size of the animal group affected the observations in many ways; both by affecting the possibility to see all animals and their different behaviours expressed during the observation time. The group size can also affect the animals itself, by influence the group dynamic and the animal behaviours. A small group with calm animals can remain calm, and a small group with aggressive and/or stressed animals can make the animals trigger each other. The same goes for big groups; a large number of calm animals can remain calm weather a big group with stressed and aggressive animals can increase the stress level in the group. Furthermore, the animals could be of great variation regarding being used to big groups and most of the cattle in Ethiopia are used to small herds with 1-3 cattle. This can also be a stressful factor in the lairage for animals not used to big groups.

### **6.1.2 Correlations of behaviours**

Using Kendall’s tau-b coefficient abusive handling by humans was correlated with animal behaviours. The most frequent expressed behaviours in the group of abusive handling were “beating of body” and “beating of head”. This two behaviours were hence tested with different behaviours expressed by the animals and the behaviour “aggressiveness” were significant negative correlated with “beating of head” (p-value=5%). This means that when the abusive handling beating of body is less expressed, the animals show less aggressiveness. Furthermore, the abusive handling “pulling by rope”, were correlated with “fighting” (p-



value=1.3%). Also here, abusive handling by the stakeholders is correlated with an aggressive behaviour expressed by the animal. Animals exposed to bad animal handling usually feel stressed (Hemsworth, 2007) and can therefore express fear and aggressive behaviours. “Pushing by hand” is another abusive handling done by stakeholders at the lairage that is significant correlated to “charging at stakeholders” (p-value=2.9%). This correlation was also seen during the observations at the lairage; where the stakeholders were trying to move the animals by pushing them using their hands, meanwhile the animals were refusing to move and were charging against the humans. The correlation between “slapping” and the animal behaviour “vocalisation 2” are also significant (p-value=6.3%). Furthermore, “kicking the animal” is significant correlated to “charging at stakeholders” (p-value=0.6%) and “tail pulling” is significant correlated to the stress-related behaviour “panting” (p-value=4.5%). All this three correlations just confirm animal welfare problems in the lairage. OIE states in their Terrestrial Animal Health Code (OIE, 2012) the importance of treating the animals with good animal welfare. In article 7.5, chapter 7.5.3, they specify that “*under no circumstances should animal handlers resort to violent acts to move animals*”. According to the Five Freedoms, stated by (FAWC, 2013), all animals kept by humans should be protected from unnecessary suffering and be free from pain and discomfort. However, it is important to highlight the possible source of error of observing animal and human behaviours. Variables of human interaction and animal behaviours can be affecting on each other and shall be taken into account when discussing the results.

## 6.2 Slaughter process

During the recording of the slaughter process, the animals were observed. Throughout the slaughter, the animals were observed expressing stress-related behaviours; such as vocalisation 2, head swings and moving forward 2. The environment inside the slaughter hall was stressful for the animal with high volume and lots of activity by humans and animals. The first problem to observe during the slaughter process was the wet and slippery floor due to a constant water and blood flow. When the animals resisted moving, they easily slipped on the wet floor and both the butchers and animals were exposed to high risk of injuries. The constant water flow could also be observed as a hygiene problem; the water in Ethiopia is contaminated with lots of bacteria’s (FAO, 2013) and shall not be in contact with the carcass. To use water during slaughter can also be a health risk in itself, since wet slaughter has been shown to have a higher risk of letting bacteria’s grow in the wet environment on the carcass (Helps, o.a., 2002). To avoid this, the slaughter should be done in a dry environment, non-favourable for the bacteria’s growth (FAO, 2013). In this aspect, it is also important to further investigate the time of slaughter; how long does it take between killing and delivery of meat? The time of slaughter is important in many aspects and can be an important factor for the meat quality. Another hygiene and health problem is the step where the carcass is divided into two, by using an axe and cut directly on the bone marrow. As soon as the bone marrow is touched, the risk of spreading possible Bovine Spongiform Encephalopathy, BSE, is very high (Helps, o.a., 2002).

The carcass and meat quality was also observed. At the body, large amounts of bruises could be detected clotted blood collected as darker areas on the carcass. The bruises were mostly detected in the back areas, around the upper back and on the hind limbs. The head and legs were separated from the carcass and could not be inspected. However, the meat was not examined further and no pH-value was recorded; measurements necessary for further studies of the DFD and PSE.

Regarding the animal handling during slaughter, animal welfare was not taken into consideration. The knowledge about animal welfare among the employees at the abattoir was lacking and the international guidelines from the World Organisation for Animal Health (OIE, 2012) were not followed. During the killing, the animals are fully aware and feel pain (Gregory et al., 2010). In this study, the eye reflex could be observed during both the stabbing of the animal's neck and cutting of their head, results that verify the previous studies about animals feeling pain. Regarding the impact of observers during slaughter, the butchers' behaviours were not taken into consideration. You can assume that observers influenced the butchers while taking pictures and video filming, but this is not something that was further investigated.

### **6.3 Supply chain**

The results from this study demonstrate a supply chain between Kera abattoir and eight markets, most frequently used for supplying cattle to the abattoir; four from Addis Abeba and four outside the capital. The distance between abattoir and market vary from <1 km to >600 km and can be discussed whether this is a proper supply chain. The markets used from around Addis is close by, but to transport animals from Jimma, Harar and Borena; more than 450 km from Addis, is not likely the most effective supply chain. The time of transport cannot be estimated since little is known about the transport system and little can be said about the transportation and animal welfare during transport to Kera abattoir. To be able to discuss this, more information would be needed and a study where the transported animals were followed and observed should be required. The study visit to Kara-Alo market gave a first hint about animal welfare during transport and two students got the chance to observe the loading, transportation and unloading of 20 animals. During the loading, the animals were pushed onto the vehicle, using man power and by forcefully closing the exit door even though the animals weren't completely on the vehicle. Limited space was provided and the animals could easily get injured and stressed due to the crowded area. Previous studies have presented the lack of education by butchers and stakeholders transporting animals in Ethiopia (Gebremedhim, 2007) and this can be a severe animal welfare problem. The short distance between Kara-Alo and Kera abattoir indicated a large number of animal welfare problems during transport, mainly due to the animal handling. If proper vehicles, with suitable space and environment for the animals could be used; discomfort for the animals could be prevented in many ways and the Five Freedoms (FAWC, 2013) could be obtained. The number of dead and injured animals during transport is not documented in this study, but would be a good measurement for further studies of the supply chain of cattle in Ethiopia. Injuries due to bad handling and death, in worst case, can result in a trivial economic loss for the customer.

### **6.4 Interview**

The interview with one employee at Kera abattoir mainly focused on the present situation for animals and butchers working on the abattoir. The main problems at Kera abattoir were shown to be lack of educated staff and the absence of reaching up to international standards, hence not being able to export meat to western countries.

## **7. Conclusions**

During this study, poor animal welfare was detected; mainly due to lack of education and absence of knowledge in animal welfare. The association between human interaction and animal behaviours was detected and showed significant correlation between abusive handling by stakeholders and aggressive and stressed animals. However, the difference between animal behaviours expressed by abusive handling and by other factors is vague. To draw further conclusions of the correlations, more distinct groups of animals must be made with more clear definitions. More studies and research needs to be done, where heart rate and glycogen should be measured regarding the animal welfare. During the slaughter process many factors can be additional investigated, and pH-value should be estimated for further conclusions of the meat quality. Animal welfare, hygiene of meat and the economic loss are all important factors of the development of cattle slaughter. Finally, to improve animal welfare of cattle in Ethiopia and hence the agricultural sector, regulations and legislation needs to be implemented.

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## Appendix 1

### Behavioural survey

CATEGORY	BEHAVIOUR	NUMBER OF ANIMALS	SUMMATION
<b>Natural behaviour</b>	Rumination		
	Smelling		
	Lying		
	Eliminations		
	Ear erecting		
	Tail erecting		
	Vocalisation 1		
	Watching around		
	Turning		
	Moving forward 1		
<b>Abusive handling by stakeholder</b>	Beating of head		
	Beating of body		
	Forcing animals to fall		
	Horn pulling		
	Kicking animal		
	Pulling animals forward		
	Pushing animals forward		
	Slapping		
	Stoning		
	Tail pulling		
<b>Aggressive behaviour</b>	Aggressiveness		
	Fighting		
	Mounting		
	Running		
	Kicking		
	Jumping		
<b>Stress-related behaviour</b>	Idling		
	Panting		
	Paralysed respiration		
	Foaming		
	Vocalisation 2		
	Stamping of feet		
	Stretching		
	Head swings		
	Moving forward 2		
<b>Resistance behaviour</b>	Charging at stakeholders		
	Refusing to leave their original place		
	Resistance to being pulled		
	Balking		
	Retreating		
	Reversing		
<b>Injuries</b>	Lameness		
	Falls		
	Slipping slightly		
	Slipping severely		



## Appendix 2

### Ethogram with definitions of animal behaviour\*

CATEGORY	BEHAVIOUR	DEFINITION
<b>Natural behaviour</b>	Rumination	The animal again chews what has been chewed and swallowed before
	Smelling	The animal breaths deep, fast and sniff air with the muzzle close to the ground
	Lying	At least two legs and stomach touches ground
	Eliminations	The animal urinates or defecates
	Ear erecting	The animal's ears are erected
	Tail erecting	The tail is not in its usual position, i.e. stands up or bent to the left or right side
	Vocalisation 1	The animal communicates with other animals, without being stressed or due to panic
	Watching around	The animal look from side to side and observe the environment
	Turning	The animal rotate from its original place
	Moving forward 1	The animal walk forward
<b>Abusive handling by stakeholder</b>	Beating of head	The stakeholder beats the animal with an object, e.g. stick, against its head
	Beating of body	The stakeholder beats the animal with an object, e.g. stick, against its body
	Forcing animals to fall	Stakeholders force the animal to fall down on the ground, using rope and/or hands
	Horn pulling	The stakeholder pulls the animal forward by its horns, using rope and/or hands
	Kicking animal	The stakeholder kicks the animal to make it move
	Pulling animals forward	The stakeholder moves the animal forward, by using rope
	Pushing animals forward	The stakeholder pushes the animal forward or to the side, by using hands
	Slapping	The stakeholder slaps' the animal using hands
	Stoning	The stakeholder throw stones on the
	Tail pulling	The stakeholder pulls the animal's tail
<b>Aggressive behaviour</b>	Aggressiveness	The animal shows aggressive behaviour, with ears pinned back, eyes wide open and/or is snaps in the air
	Fighting	The animal attacks other animals and fight
	Mounting	The animal mounts another animal
	Running	The animal moves faster than walking

	Kicking	The animal kicks against the stakeholder
	Jumping	The animal jumps with less than two feet touching ground
<b>Stress-related behaviour</b>	Idling	The animal stands/lies down and do not want to move
	Panting	The animal breaths rapid and inhales for air
	Paralysed respiration	The animal breaths slow due to stress
	Foaming	The animal produces saliva in large amount
	Vocalisation 2	The animal vocalise with high squeals due to stress or panic
	Stamping of feet	The animal stamps with one or more feet on the ground
	Stretching	The animal extends the body due to stress
	Head swings	The animal swing head from side to side
	Moving forward 2	The animal moves faster due to stress or panic
<b>Resistance behaviour</b>	Charging at stakeholders	The animal charges at stakeholders
	Refusing to leave their original place	The animal stands still and refuses to move
	Resistance to being pulled	The animal stand up and resists to being pulled by stakeholders
	Balking	The animal lies down and resists to being moved by stakeholders
	Retreating	The animal moves backwards
	Reversing	The animal changes direction and moves against animal flow
<b>Injuries</b>	Lameness	The animal is lame on one or more legs
	Falls	The animal falls down with any part of the body touching ground
	Slipping slightly	The animal loses its balance temporarily but remains straight
	Slipping severely	The animal loses its balance and almost fall down

\*Based on literature: (Aradom et al., 2012)

## Appendix 3

### Interview with Tekola at Addis Abeba Kera abattoir

1. How long have you worked at the abattoir?

---

2. What is your background? Education?

---

#### **TRANSPORT**

3. From where are you collecting animals? How many km from Kera and how long time does the transport take?

---

4. How many animals do you have in one vehicle?

---

5. Are there any injured animals during transport?

---

6. Are there any dead animals during transport?

---

7. Are the injured animals treated? Are there any veterinaries on the abattoir? What is there role?

---

8. How do you choose the animals that you buy?

---

9. Do you see any problem with the transport system?

---

#### **LAIRAGE**

10. Is there provision of the following management activities at the lairage?

Rest Yes

Shelter No

Food Yes How often? \_\_\_\_\_

Water Yes How often? \_\_\_\_\_

11. Is it usual with injured animals in the lairage?

---

12. Is it usual with dead animals in the lairage due to bad condition?

---

13. What are you doing with the calves? Are they slaughtered?

---

14. How long are the animals at the lairage before slaughter?

---

**ABATTOIR**

15. How do you consider meat yield & quality?

Meat yield \_\_\_\_\_  
Meat colour \_\_\_\_\_  
Bruising \_\_\_\_\_  
Fat colour \_\_\_\_\_  
Fat quantity \_\_\_\_\_

16. What happens with the .....?

Skin \_\_\_\_\_  
Carcass \_\_\_\_\_  
Hooves \_\_\_\_\_  
Head \_\_\_\_\_  
Blood \_\_\_\_\_  
Organs \_\_\_\_\_

17. At the abattoir, what do you consider as the main problem?

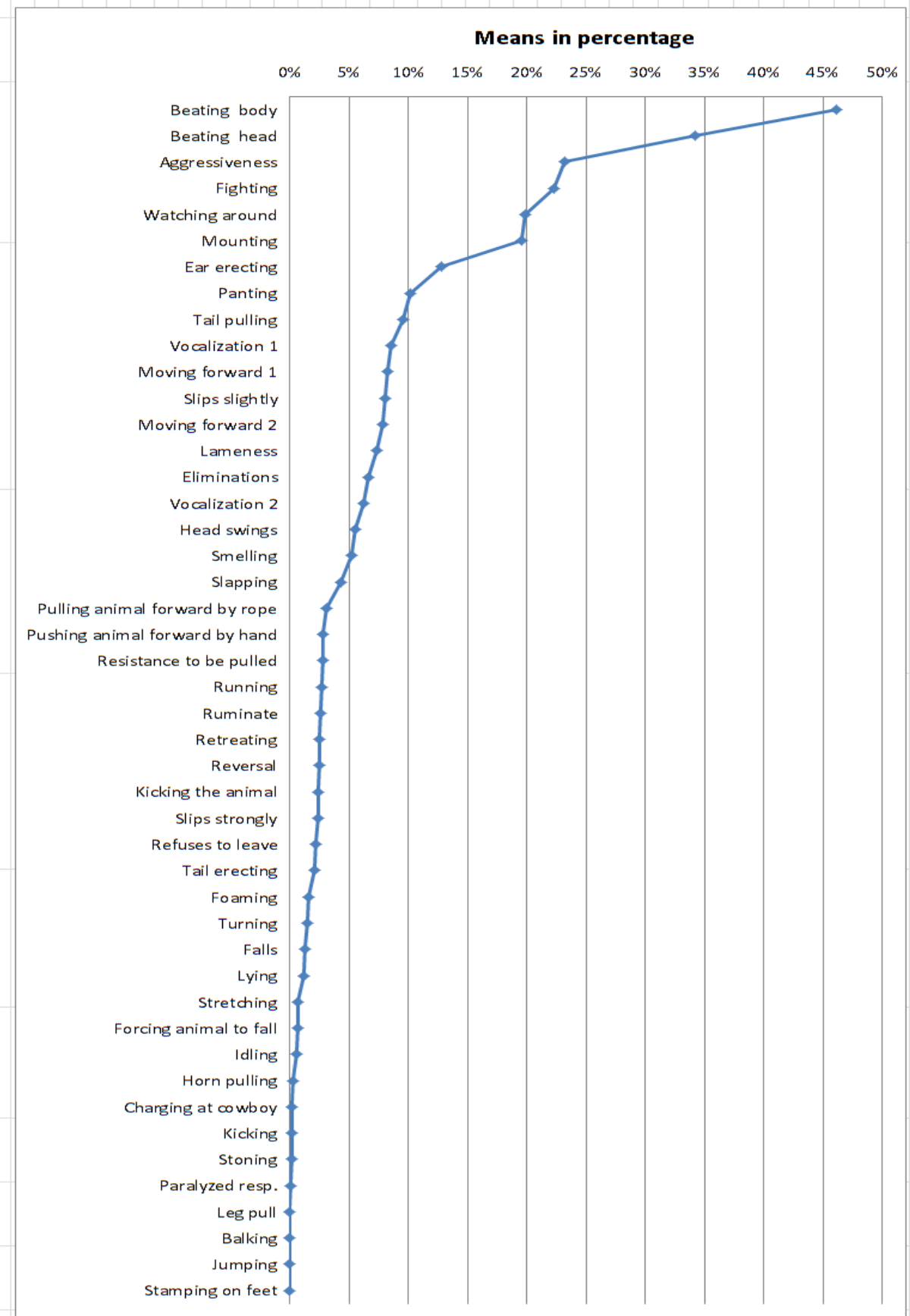
\_\_\_\_\_

18. The illegal meat, where do you collect it? Why is it illegal? Is there any punishment?

\_\_\_\_\_

## Appendix 4

Means of the frequencies of all, 46 observed behaviours at Addis Abeba Kera abattoir.



## Appendix 5

Significant correlations, calculated by Kendall's tau-b coefficient, highlighted in yellow.

The CORR Procedure											
Kendall's tau-b Correlation Coefficients ( $\tau$ ), N = 52, p-value < 5%											
	Beating head	Beating body	Pulling by rope	Pushing by hand	Slapping	Kicking the animal	Forcing animal to fall down	Horn pulling	Leg pulling	Stoning	Tail pulling
<b>Mounting</b>	$\tau$	0.026	0.068	0.207	0.226	-0.055	-0.117	-0.192	0	0.102	0.078
	p-value	0.854	0.626	0.140	0.107	0.693	0.404	0.169	0	0.467	0.576
<b>Fighting</b>	$\tau$	-0.036	-0.002	0.349	-0.045	-0.012	0.097	-0.220	0	0.089	0.054
	p-value	0.796	0.986	0.013	0.746	0.929	0.488	0.116	0	0.524	0.699
<b>Aggressiveness</b>	$\tau$	-0.198	-0.287	0.111	-0.095	0.047	0.136	-0.192	0	0.102	-0.003
	p-value	0.157	0.040	0.429	0.500	0.735	0.331	0.169	0	0.467	0.982
<b>Charging at cowboy</b>	$\tau$	0.060	0.055	-0.077	0.306	-0.068	0.388	-0.020	0	-0.020	-0.125
	p-value	0.670	0.693	0.584	0.029	0.626	0.006	0.889	0	0.889	0.373
<b>Panting</b>	$\tau$	-0.074	-0.139	0.049	0.118	0.060	0.214	0.130	0	-0.151	0.281
	p-value	0.597	0.321	0.725	0.401	0.667	0.127	0.355	0	0.280	0.045
<b>Vocalization 2</b>	$\tau$	0.086	0.050	-0.207	0.095	0.260	0.117	-0.146	0	0.192	-0.078
	p-value	0.538	0.721	0.140	0.500	0.063	0.404	0.299	0	0.169	0.576

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