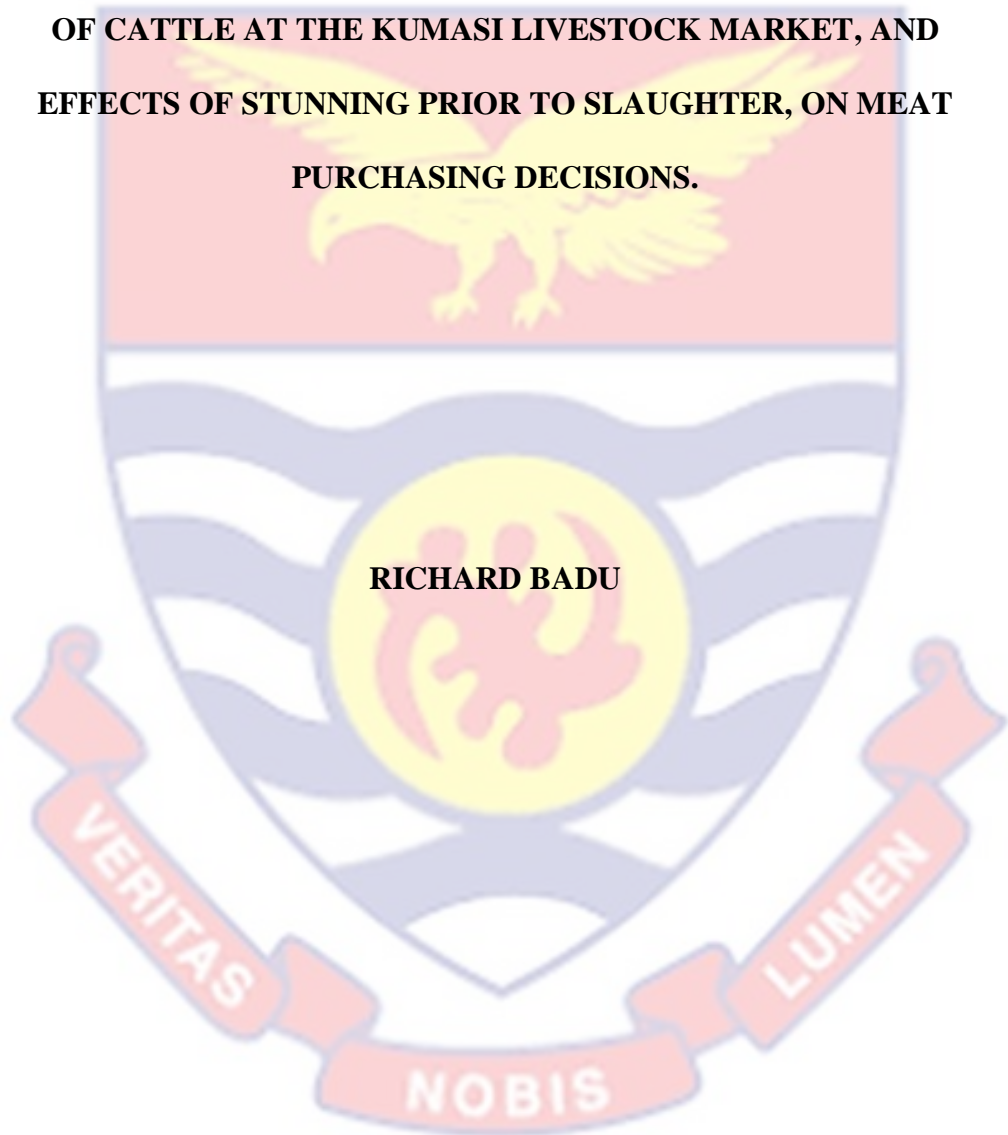


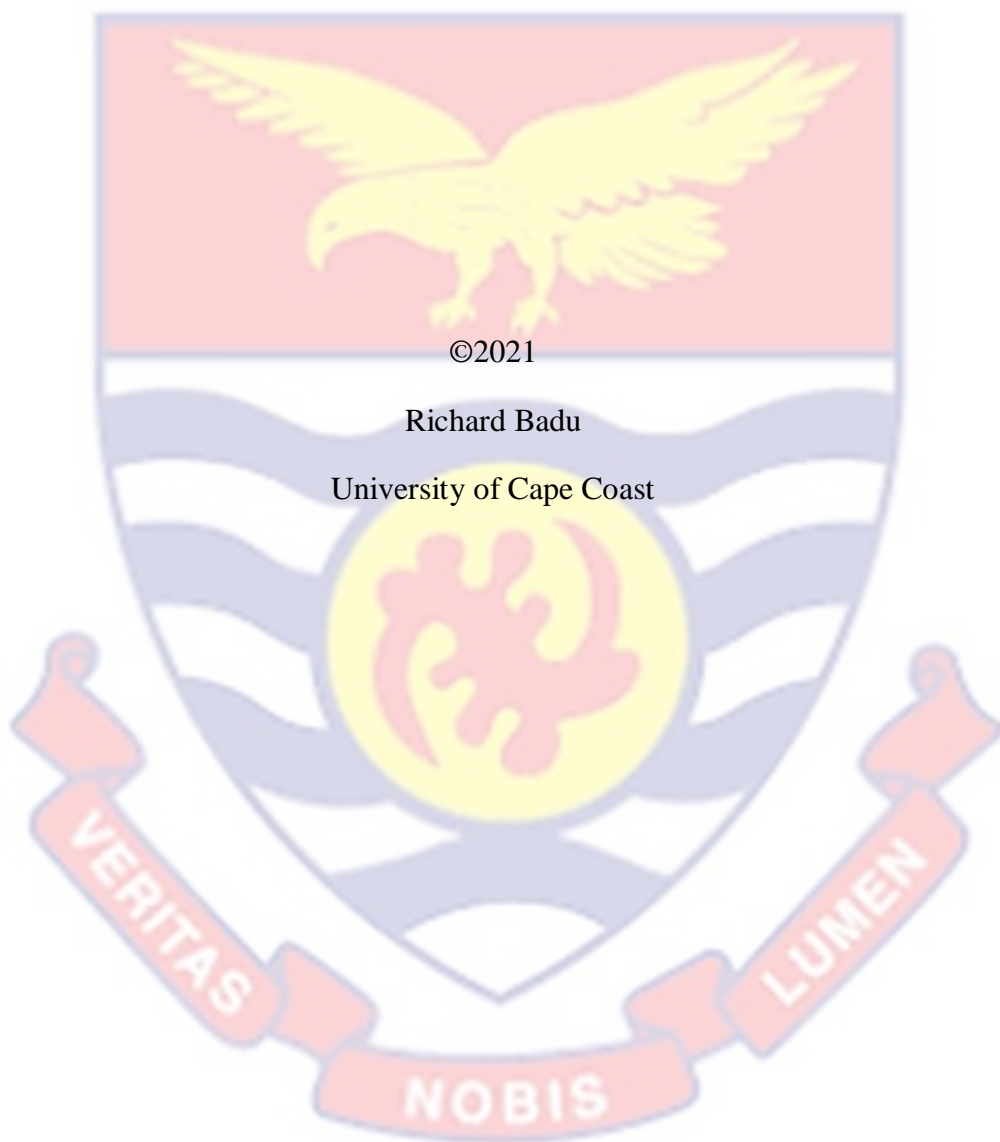
UNIVERSITY OF CAPE COAST

**TRANSPORTATION AND MARKETING PRACTICES ON WELFARE
OF CATTLE AT THE KUMASI LIVESTOCK MARKET, AND
EFFECTS OF STUNNING PRIOR TO SLAUGHTER, ON MEAT
PURCHASING DECISIONS.**



RICHARD BADU

2021



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BY

RICHARD BADU

Thesis submitted to the Department of Animal Science, School of Agriculture,
College of Agriculture and Natural Sciences, University of Cape Coast, in
partial fulfilment of the requirements for the award of Master of Philosophy
degree in Animal Science

SEPTEMBER, 2021

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research, and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: Date:.....

Name: Richard Badu

Supervisors' Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature:..... Date:.....

Name: Dr. Moses Teye

ABSTRACT

Poor handling of livestock during transport and at slaughter have associated adverse effects on animal welfare and, meat quality; it also causes economic losses in terms of reduced profit margin to farmers and processors. This study was aimed at assessing the current animal handling practices by livestock vendors and butchers on welfare, and meat purchasing intentions of consumers in selected locations in Ghana. Abattoirs from Cape Coast, Kumasi and Tamale which were selected, received training in humane slaughter, and supplied with captive bolt stunners were interviewed. The study population consisted of 50 livestock transporters, 40 livestock owners, and 6 butchers. The study also involved 170 meat consumers and 19 Islamic scholars from selected communities in the Ashanti Region - Kumasi. Descriptive statistics tool and Probit Regression Model in SPSS (version 25, 2017) were used to analyse the data, findings were presented in tables, in the form of frequencies and percentages. It was observed that majority (94.4%) of the meat consumers had no idea about what pre-slaughter stunning of livestock entails. Vehicles used to transport livestock were generally in bad condition and needed immediate improvement. Mortalities recorded in this study were 2.5% (23 dead animals out of 922 transported) and 1.3% (8 dead out of 633 transported) cattle sourced from neighbouring countries and from within Ghana respectively, over a period of 4weeks. The captive bolt stunners previously donated to the selected butchers were either non-functional or in poor working condition. Further studies should be conducted to assess the effect of the handling practices on carcass quality and other economic losses experienced in cattle transported over long-distance for slaughter in Ghana.

KEYWORDS

Animal welfare

Livestock transport

Stunning

Captive Bolt stunner

Islamic Scholars

Livestock Marketing

Slaughter Practices



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DEDICATION

This study is dedicated to the memory of my late father, Nana Kofi Badu.



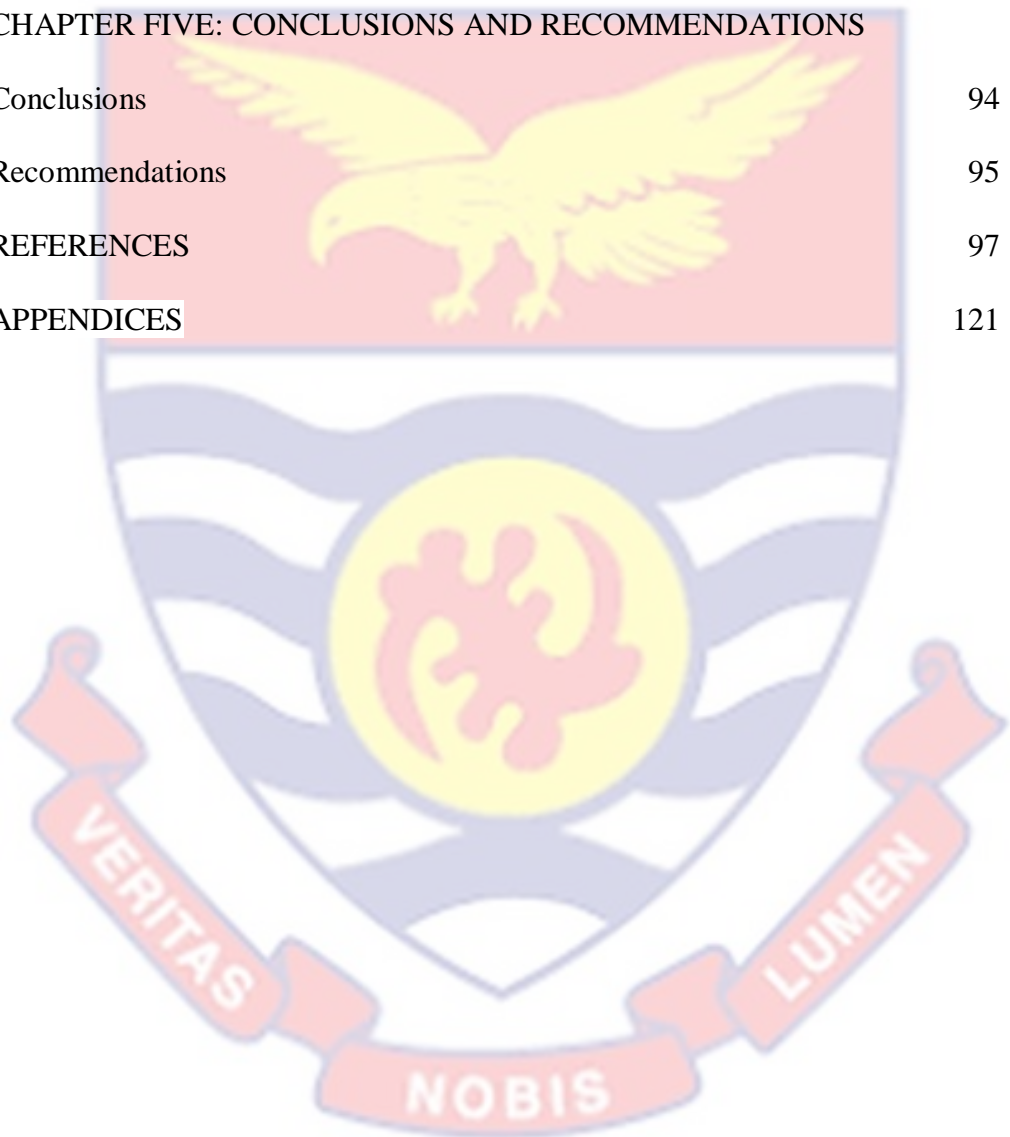
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LIST OF ACRONYMS

AVMA	American Veterinary Medical Association
BHB	Beta-Hydroxybutyrate
CK	Creatine Kinase
CO ₂	Carbon Dioxide
DFD	Dark Firm and Dry
DFID	Department for International Development
EC	European Commission
EonA	Eyes on Animals
EU	European Union
FAWC	Farm Animal Welfare Council
GRA	Ghana Revenue Authority
IFC	International Finance Corporation
MoFA	Ministry of Food and Agriculture
NEFA	Non-Esterified Fatty Acid
OIE	World Organization for Animal Health
PSE	Pale, Soft and Exudative
SPSS	Statistical Package for the Social Sciences
USA	United States of America
WACPAW	West African Centre for the Protection of Animal Welfare

CHAPTER ONE

INTRODUCTION

Background of the Study

Humans derive many benefits from animals. These include use as a source of food, companionship, clothing and income. Livestock keeping is a significant component of the agricultural sector and is crucial in the Ghanaian farming and livelihood systems. MoFA/DFID (2002) reported that livestock development in the country is a relevant input to ensure zero hunger, make farming more intense and eradicate poverty, primarily among the poor in the rural communities. According to Madzingira (2018), the increasing global population with its increasing demand for food has led to intensification of animal production. Livestock intensification systems are aimed at increasing output while utilizing limited land resources in order to maximize profit.

Despite advancements in animal production techniques recently, livestock welfare remains a significant concern, especially in developing countries (Madzingira, 2018). Some livestock in developing countries are provided with inadequate or no housing facilities, have inadequate access to good quality feed, and are transported, marketed and slaughtered under cruel conditions. In most slaughterhouses, livestock are slaughtered while conscious, and in the presence of other live animals. This is usually considered as inhumane and morally wrong. Some animals, out of fear of being slaughtered, end up struggling with the personnel in the slaughterhouse, and cause injuries to themselves or personnel, and end up destroying some equipment in the slaughterhouse. Meanwhile, poor handling of livestock during production, transport and at slaughter have their associated adverse

effects on meat quality, product patronage and storability. Some defects such as bruises on livestock, Dark, Firm and Dry (DFD) and Pale, Soft and Exudative (PSE) conditions reduce significantly the quality, yield and patronage of meat, causing economic losses or reduced profit margin to farmers and processors (Knowles, Maunder & Warriss 1994). Consequently, the welfare of livestock has been a source of serious worry for many years (Ouédraogo & Le Neindre, 1999). Specifically, many countries have concerns about the consequence of transportation and accompanying handling treatment, on animal wellbeing.

The World Organization for Animal Health (OIE, 2011) defines animal welfare as “*how an animal deals effectively with the conditions in which it lives*”. Consequently, an animal is considered to be in a good state of wellbeing if it is well fed, is relieved from suffering and fear, is healthy, and can exhibit normal behavioural characteristics peculiar to that species.

Animal welfare issues, and the general understanding available on this subject, represent the summary results that come forth and accumulate from many kinds of research conducted in previous years. Farm animals are affected by human-imposed stressors, as presently, the choice of practice has been focused on efficiency of production. However, it is an increasingly accepted view that animals should be safeguarded against maltreatment (European Commission, 2012). Also, to safeguard the welfare and evade suffering, an extensive range of needs must be fulfilled. According to Vestergaard (1996), these needs may include providing the animal with feed, shelter, health care and, good transport systems, so that they respond favourably to stimuli or can exhibit innate behaviour.

Problem Statement

A large number of animals are transported daily across the country. Many studies have been conducted to identify the risk factors for slaughter animals prior to, during and post transport. Re-grouping animals or mixing them with unfamiliar animals, transporting sick animals, loading animals of different age groups and loading different species of animals together in the same truck are some of the risk factors that adversely affect animal welfare during transport.

Food and water deprivation, exposure to vibrations from the truck overcrowding, adverse environmental conditions (heat, wind and rain), truck condition, journey length and duration which result in starvation and thirst, weight loss, hyperthermia, injuries, death, and morbidity, are some of the other risk factors that livestock transported for slaughter encounter (Schwartzkopf-Genswein *et al.*, 2012). More so, handling during unloading, lairage time conditions and rest period, and re-grouping are other significant risk factors post transport. The effects of stress on animals can vary depending on a number of factors, including the nature of the operation and the expertise of the handlers (Grandin, 2001a). Moreover, as Warriss (1990) reported, mishandling of animals prior to slaughter; beating them with sticks, stones and twisting of tails could result in various degrees of bruises, DFD or PSE conditions, which degrade carcasses and affect the economic value of meat.

In Ghana, livestock handling and slaughter is currently done by people without any qualification or formal training, consequently meat from such animals are often unappealing to consumers. According to Anala (2007), butchering in Ghana is a traditional business practiced on a family lineage

from one generation to another. Consequently, one does not need any qualification or knowledge in meat processing to become a butcher in Ghana. In most slaughterhouses in Ghana, livestock are slaughtered while conscious, contrary to the FAO guideline for slaughter which states that “*it is desired to render livestock unconscious before slaughter in order to eliminate pain, discomfort and stress from the procedure*” (Heinz & Srisuvan, 2001). This has dramatically obstructed appreciation of good hygiene and safety practices, leading to unhygienic slaughtering and handling of meat across the country. Most butchers in Ghana rely on traditional slaughtering methods on the bare floor, even where modern facilities are available, partly due to a low educational background of personnel (Adzitey, Teye & Dinko, 2011). Consequently, fresh fish and meat produced locally are often not allowed into Western countries for sale to earn foreign exchange because such products do not meet high international standards (Frimpong, Gebresenbet, Bosona, Bobobee & Aklaku, 2012).

Notwithstanding the guidance and null tolerance of Islam and non-religious sources to livestock abuse, there is evidence of poor handling practices and abuse of animals during halal and non-halal slaughters (Farouk, Pufpaff, & Amir, 2016). Stunning of animals works by disrupting normal brain function, resulting in loss of sensibility and perception of pain associated with neck cutting. This is echoed by previous authors who reported that stunning is a procedure which renders animals unconscious, so they become insensible to pain at slaughter (Velarde *et al.*, 2014). Due to the discrepancies that exist between Islamic jurists in the interpretation of Islamic scriptures, some Muslim authorities accept stunning prior to slaughter, whilst others do

not. Proponents of stunning for halal meat production insist that stunning is acceptable on condition that it does not kill the animal before exsanguination, whereas opponents of halal stunning reject it on the grounds that stunning is not an Islamic practice (Bonne & Verbeke, 2008). Opponents of halal stunning further argue that stunning does not always guarantee that the animal is alive during bleeding. These disagreements have led to the existence of different halal standards issued by the major Halal Certification Bodies (HCBs) around the globe. Consequently, animal welfare researchers, meat processors, and consumers are uncertain about the rules of halal meat production. This has meant that some Muslims will not consume meat unless they have been slaughtered in line with traditional religious values (without stunning).

Despite the popularity of pre-slaughter stunning in the industrialized world, it appears to be a relatively new slaughter technique in the developing economies, including Ghana (Adzitey, Teye, Dinko, 2011).

Efforts by players in the meat industry to overcome this unfortunate situation, within the last few years brought some international livestock organizations into Ghana to train butchers and livestock handlers to improve their handling skills, and standards of operation in general, so as to help meet international standards.

General Objectives

This study was aimed at the assessment of transportation, marketing and slaughtering practices, on general welfare of cattle (*bos taurus*) and the effects of stunning prior to slaughter on meat purchasing decisions of consumers.

Specific Objectives

The specific objectives of the study were to:

1. assess the conditions under which livestock are transported from the places of origin to the Kumasi Livestock Market.
2. evaluate perception of commercial livestock transporters on animal welfare requirements.
3. assess the conditions under which livestock are kept at the Kumasi Livestock Market.
4. assess the use of some humane slaughter equipment introduced to selected slaughterhouses, and challenges associated with their use
5. evaluate the opinion of selected Ghanaian meat consumers on pre-slaughter stunning practices, and its effects on their meat purchasing intentions
6. evaluate the opinion of Islamic scholars in Ghana, on pre-slaughter stunning of livestock

Significance of the Study

The study will provide information on:

1. the state and suitability of vehicles used in transporting livestock to slaughterhouses in Ghana.
2. training needs of livestock handlers and butchers in Ghana required, to improve their operations and bring these up to international standard.
3. Welfare aspects of handling in livestock markets and slaughterhouses for the attention and necessary action of stakeholders (operators and regulatory bodies).
4. the feasibility of adopting humane slaughter practices in slaughterhouses in Ghana.

5. consumer acceptability of meat from stunned animals, especially in Muslim communities.

Limitations to the Study

Some respondents were unwilling to respond to most of the questions asked, as there was no financial or fringe benefits directly associated with participating in this study. Language barrier also posed a challenge to this study, as some respondents from Northern Ghana were not conversant with the Akan dialect or the English Language.



CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter takes a critical review of scholarly materials in the areas relevant to this study to support substantive arguments.

Welfare Concerns in Commercial Livestock Production

In recent years, intensification of livestock production aimed at ensuring zero hunger to meet the increased food demand globally and thus help to solve food security issues. Consequently, many livestock species are produced in comparatively limited spaces with minimum regard to their welfare (Madzingira, 2018). Breeding programs emphasize production qualities and do not focus much on livestock animals' essential physical and mental welfare. For instance, the dairy cows bred lately can produce higher volumes of milk but have enlarged pendulous udder at risk of being prone to mastitis (da Silva, Siqueira, Martins, Ferreira & da Silva, 2004). Primarily, present studies on animal welfare are geared towards livestock species because of their vital role in human lives. This has caused an increase in research and training programs in universities and public services to increase awareness of animal welfare (Walker, Diez-Leon & Mason, 2014).

The concept of animal welfare has no limited definition; however, several thoughts and exposition could be considered depending on one's previous experience and moral values. Due to diverse moral assessments, knowledge, and skills within a community, there may be varied views and ethical stances on animal welfare. According to Hewson (2003) and OIE (2011), the most accepted general definition of animal welfare is “*how well a*

creature is adapting to the conditions wherein it lives". This is explained as making sure that animals are not maltreated or exposed to needless pain and suffering. Thus, it shows how well an animal deals with both physical and mental conditions within an environment. The welfare of animals may be pleasant if animals could deal with the limited resources with minimum effort. However, in other circumstances, animals may be unsuccessful in coping with negative or poor well-being (Broom, 1991).

Ultimately, animal welfare alludes to the emotional and physical condition delivered in animals by human influence and action, the sum of available resources and the quality of an animal, and the environment where it lives. Mental well-being is especially significant because livestock are sentient creatures which have emotions and feelings, and can accordingly endure mental distress (Broom, 2016). According to Madzingira (2018), good and bad encounters are worthy of an animal's life as long it can cope. In any case, physical and mental distress that surpasses an animals' capacity to adapt ought to be beyond what many would consider the lowest practicable limit.

The five freedoms of animal welfare can be utilized as a basis for characterizing and evaluating welfare (FAWC, 1993). The five freedoms to be relevant to livestock there is a need for previous information and understanding of species-explicit needs for practical usage. The focal point of four of the five freedoms is on soothing pain or getting rid of the negative aspects that impede animals' health. In any case, one out of the 'five freedoms' looks to advance the excellent feature by recommending for animals to be presented with an environment that allow them to exhibit innate behaviour. The 'five freedoms' are essential as a reason for forestalling animal suffering

and poor welfare. They have far-reaching acknowledgment by international agencies, animal welfare proponents, and the World Organization for Animal Health (OIE), and have been consolidated into numerous guidelines of operation globally.

The five areas incorporate nutrition, environment, health, behaviour, just and as an all-encompassing mental aspect (Mellor & Beausoleil, 2015). The OIE has established rules and guidelines to advance global trade between World Trade Organization individuals (OIE). Although not compulsory, these standards advance and ease commerce among member countries of OIE.

The five freedoms of food producing animals

1. freedom from hunger and thirst by ensuring regular access to good quality diet and freshwater to keep up good health.
2. freedom from discomfort by providing suitable environmental condition which includes shelter and a good resting place.
3. freedom from pain, injury or illness by forestalling fast finding and treatment of ailment.
4. freedom to exhibit innate behaviour characteristic to that species by providing adequate space, suitable facilities, and social connection in a group of its kind.
5. freedom from distress and fear by avoiding conditions that predispose animals to mental suffering.

An animal is in a decent welfare condition by and large because the animal is well fed, liberated from pain, fear, and discomfort, finds it easy to exhibit normal behaviour, and is healthy (OIE, 2011). Good husbandry practices such as prevention and control of disease, humane handling and

slaughter, and providing good quality feed and shelter are prerequisites for a good welfare condition (Bousfield & Brown, 2010).

Proof that an animal has a decent condition of welfare, according to Broom (2016), involves a low degree of illness, showing natural behaviour, usual procreation, and living longer. Poor welfare can show high death rates, low reproductive performance, expanded disease occurrence, injuries to the body, abnormal behaviour, substantial loads of both endo and ecto parasites, and severe lack of balanced diet—based on the fact that animals are sentient beings and are conscious of their emotions. Human interest in animal welfare depends on the mindfulness that animals are aware of and that they have an essential role in human lives. According to Broom (2016), livestock are conscious of the environment, meaning that they have sentiment and feeling. Accordingly, they can suffer pain and distress yet, also experience joy and satisfaction. Some examples of complex capacities that feature sentience in some livestock are highlighted.

Held, Mendl, Devereux and Byrne (2000) stated that pigs could utilize stratagem and knowledge by others in search of feed or nourishment. Cattle are animals that esteem social relation with others (Munksgaard, Jensen, Pedersen, Hansen and Matthews, 2005), and according to Fraser and Broom (1997), cattle can reminisce up to fifty to seventy other individuals in a social group. On the other hand, chickens can practice self-control and indicate emotional displeasure (Abeyesinghe, Nicol, Hartnell & Wathes, 2005).

Various Perspectives concerning Animal Welfare

Society's opinions on animal welfare are controlled by changing degrees of social customs or beliefs and economic perspectives. Among the

many, two different perspectives are exceptional; the animal welfare and the animal rights perspectives. One school of thought promotes the reasonable utilization of animals as far as their welfare is not compromised and they are not inflicted by needless pain and suffering that cause discomfort. However, others in society cannot help protesting the utilization of animals by man. They promote that animals ought to be afforded fundamental rights and not to be abused by man.

These are people who promote animal rights and see animals as equivalent to humans, and are against the misuse of animals in any regard. The animal rights advocates' opinion is an ethical judgment wherein animals are perceived as having rights that go past the welfare considerations. A portion of these rights compares to the rights that stood to people (Regan, 2004). Although the two perspectives are frequently different, there is some union in that the two perspectives look to improve animals' welfare (Phillips, 2009). A summary of the perspectives on animal welfare and animal rights advocates are introduced in Table 1.

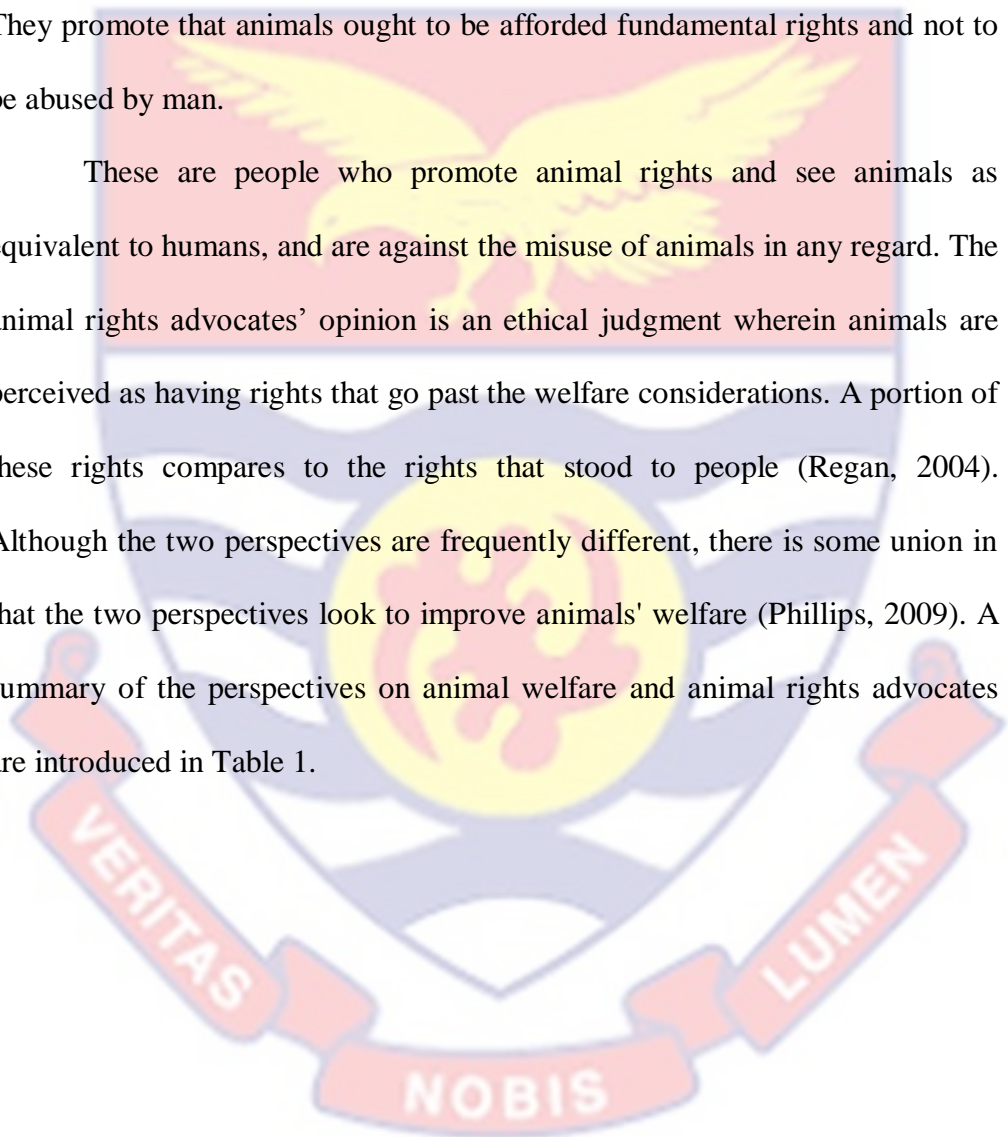


Table 1: Animal Welfare vs. Animal Right

Animal welfare advocates	Animal rights advocates
The use of animals for human advantage is ethically right when done judiciously	Using animals for human advantage is ethically unjust
Human interests consistently start things out before animal interests	Human interests do not usurp animal interests
Human ought not to cause animal needless pain or death	By no means should human actions cause pain or death to an animal
Treat animals as accommodatingly as helpfully conceivable	Treat animals consciously and consistently, and dispose of human-made reasons for animal pain and suffering
Humane slaughtering/killing of animals	No killing of animals
Disagree to awful practices, for example, dog battling, restriction of veal calves, and pregnant sows	Abrogate the utilization of animals in any structure; it is misused. Animals have equal fundamental rights as humans

Source: www.evolvecampaigns.org.uk

Products such as meat, milk, eggs, and traction power are some benefits humans derive from livestock. Similarly, as people look for some close-to-home profit by a day of challenging work, people should also merit support for the benefit they derive from animals. In this manner, people have an ethical commitment to guarantee that livestock have decent welfare satisfaction (Brooke, 2018).

Consideration animal welfare can improve efficiency, quality, sanitation, and monetary returns in food production systems (Grandin, 1995) and add to food security and financial thriving. Enthusiasm for animal welfare is on the ascendency around the globe. More consideration is currently set on animal welfare in research works, the media, and legislative issues. The well-being of animals has been on the OIE plan for longer than ten years due to its connection to animal health and food hygiene, thus connected to human health. A decrease in disease infections is straightforwardly connected to a decrease in zoonotic disease in people. In certain parts of the world, animal welfare currently impacts animal products' local and universal exchange. A connection between animal welfare and production efficiency is reported all around. Rushen (2001) stated that decreased milk output and reproductive limit are characteristic of a lame dairy cow, decreasing production profits.

The well-being and health of livestock can directly affect growth development and reproduction or quality of meat which is significant to farmers, food vendors, consumers, and others in the livestock supply chain. Compliance with animal welfare rules and regulations can produce business benefits by increasing profitability and effectiveness, and decreasing losses (International Finance Corporation. IFC, 2014). In some nations, it is a legitimate prerequisite to accommodate the necessities of animals. In the meat industry, effective and satisfactory animal welfare has the following economic advantages:

- Reduced incidence of carcass damage because of bruises and injuries
- Reduced meat condemnation as a result of DFD and PSE conditions
- A decrease in worker mishap during animal handling and stunning

- A decrease in labour cost because of the smooth and simple movement of animals through a pen, race, and restrained
- Improved open impression of the meat business industry, which can fill in as a marketing tool (Grandin, 1995)

Farm animal welfare

Animal welfare concerns on beef cattle farms

Beef cattle production for commercial purposes can be categorized as an extensive, intensive and semi-intensive production system. In the extensive system of production, beef cattle are reared outdoor on the field. Outdoor livestock can select their food, water and shelter, and also have enough space for exercise, and to exhibit their innate habits essential for their welfare. Extensive production systems also provide many benefits since they are nearest to an animal's natural habitat. However, the welfare state of livestock reared on extensive systems also hangs on the amount and nature of the feed accessible and on how livestock are handled. Extensive systems are the pre-eminent opportunity, with good management, to provide livestock with the right conditions for their welfare. Usually, minimum effort goes into managing extensive cattle production systems, leading to poor cattle welfare. Supplementary feeding is essential during times of drought to maintain animal health. Because of the farmland's size, regular inspection of the condition of all the animals can be complex.

Accordingly, a few animals may experience the ill effect of injuries or dystocia because some farms are large. Farm animals raised on pastures appear to bear heavy ecto and endo parasite burdens. Predators frequently attack calves and smaller livestock, and may cause injury to older ones. On

large livestock production farms, specific animal welfare issues include heat stress caused by a lack of shelter, mixing unfamiliar animals resulting in constant fights, poor supervision of young animals, particularly for colostrum ingestion, and stressful husbandry treatments such as castration, dehorning, animal identification, and branding with a hot iron, which are all performed with no anaesthetics.

Farm animals are restricted in intensive production systems and rely entirely on humans for necessities, including shelter, water and food. Hence, their welfare depends on the efficiency of farm management. High stocking densities in intensive production systems can reduce welfare because the risk of disease infection and competition for feed is high. Animals are unable to perform some of their explicit natural behaviours because of the limited space.

On the other hand, a semi-intensive production system is a mix of intensive and extensive production systems. It has the benefits of both systems, and semi-intensive systems give the best welfare in theory compared with the other two.

The role of the stockman in livestock handling

The handling of livestock restricting and brings them closer to humans than they would in their natural surroundings. It is stressful, particularly for animals who are not used to being handled. Young animals should be in day-by-day contact with the stockman to not be too terrified when they are handled (de Passillé & Rushen, 2016). Most livestock may display signs of happiness and discomfort, while emotional stress may not be apparent in others.

Stockman should be very much prepared, skilled, show sympathy, and recognize animal welfare issues early and find corrective action in the most limited conceivable time. Animals in any production system should be frequently checked to identify any issues and conditions that may affect welfare. For instance, lactating cows should be reviewed in any event once per day. A few animals may be inspected more often, for instance, neonatal calves, dairy animals in late gestation, recently weaned calves, cows suffering from environmental stress, and those who have gone through painful husbandry practices including veterinary treatment (Botha *et al.*, 2014).

A good stockman should be familiar with social changes that show poor welfare. The demeanour towards livestock additionally matters. Indeed, even skilled stockmen can add to poor welfare if they have a pessimistic attitude towards animals. Poorly designed and constructed structures can inflict injuries to animals from sharp protrusion, or fractures from stuck legs, and slippery surfaces. Handling and restraining animals should be firm, yet efficient. The following practices and principles help ensure that all animal species on the farm are handled and restrained safely, humanely, and effectively:

- Designed facilities suitable for each animal, stable sides, adequately illuminated, non-slip surface with no projections can injury.
- Use only trained and skilled animal care workers.
- Take advantage of animal behaviour by utilizing the flight zone and the point of equilibrium to move livestock.
- Use an appropriate form of restraining suitable for each animal to avoid accidents. Stop making sounds that agitate animals.

Assessment of Animal Welfare Amidst Transport and Related Handling

Animal welfare and the safety and quality of meat can be compromised during pre-slaughter handling at different production phases. In cattle, specific indicators, such as the appearance of bruises in carcasses or extreme muscular pH, and also carcass condemnation for health reasons, may be considered as post-mortem welfare indicators because they are the signs of poor welfare in the production process or during pre-slaughter handling (Ferguson & Warner, 2008; Galindo & Manteca, 2001). Such meat defects often cause economic losses for the meat industry (Gallo & Huertas, 2016).

Transportation of livestock is typically a significant stressor. One can understand that thousands of cattle are transported either to slaughter, sale markets, or to other farms at least once in their production period (Weeks, McNally & Warriss, 2002). Trucks are perhaps the most common means of transporting livestock. Moreover, several studies indicate a close relationship regarding pre-slaughter cattle handling and carcass degrading (Grigor *et al.*, 1997; Knowles, 1999; Knowles, Warriss, Brown & Edwards, 1999). Loading, stocking density, driving standards, and road conditions are also essential considerations for animal welfare and meat quality (Ruiz-De-La-Torre *et al.*, 2001). Besides, Grandin (1989) and other studies conducted by Gallo, Lizondo and Knowles (2003) and Villarroel *et al.* (2001) confirmed that long-distance travel could cause stress and physical harm to animals. Weight loss, severe injury, or (in severe cases) death may result from poor transport control resulting in significant economic losses (Knowles *et al.*, 1993).

In the tropics, particularly Africa, most livestock transported commercially under adverse environmental conditions, over a very long period

of 2–3 days are indigenous cattle breeds (Ayo & Oladele, 1996). Despite the increasing number of livestock transported daily in this area and the vital role livestock plays in the West African region's economy, there is little knowledge record available on the occurrence of serious injuries suffered during livestock transport.

Behaviour Assessment

Behavioural changes mostly show that some handling and transport conditions are aversive and signal that an animal has difficulty coping. Animals may expose behaviours like lying down, vocalizing, running away, backing up, or avoiding movement. Grandin (1989) reported that cattle halt their movement upon encountering to dark places; more so, pigs freeze when they are struck or exposed to other frightening circumstances.

The magnitude of behavioural reactions to stressful or otherwise uncomfortable circumstances ranges from one individual to another based on the selective pressures that have arisen through behaviour control development. Human intervention and interaction can contribute to anti-predator actions in farm animals, depending on the species' experience in human interactions (Hemsworth & Coleman, 2010). Social animals that can act together in defending against predators, for instance, or humans, squeal a lot when trapped or wounded. Animals that are likely unable to protect themselves, like sheep, scream even less, possibly because an excessive reaction will inform the predator that the animal being targeted is seriously wounded and thus unlikely to flee. Cattle may also be reasonably undemonstrative, whether it is injured or psychologically traumatized.

According to Broom and Johnson (1993), pigs shriek when wounded, while sheep do not exhibit a significant response to the same measure of injury. However, human handlers often mistakenly assume that an animal is not harmed or disturbed because it does not vocalize in response to the actions being subjected to. In certain situations, an animal has a freezing response and, in many other situations, physiological tests ought to be used to assess the animal's overall reaction. Parrott, Hall and Lloyd (1998) have observed that sheep experience primarily physiological rather than behavioural responses related to the unusual conditions found in the truck rather than to the loading phase. On the contrary, pigs are more disturbed by being pushed up a ramp into a truck, with a more significant impact if the ramp is steep.

Responses to potential stressors may differ among individual animals. The adaptive mechanism adopted by the animal may influence the responses to the transport and lairage circumstances. Skin damage vary during pre and post- transport according to Geverink, Bradshaw, Lambooij, Wiegant and Broom (1998). They found that the most aggressive pigs in their pens are often likely to fight before transport and at slaughter, but pigs which moved for quite a distance pre transport were less likely to fight. This premise can be utilized to develop a test that will indicate in any case, the animals that will be significantly harmed as a result of the transport condition (Lambooij, Geverink, Broom & Bradshaw, 1996).

Once hens are released from an enclosure, they flee from an incoming person. Broiler chickens or turkeys, who are far less agile than hens, do not necessarily flee in attempt to capture them because, with time, their actions suggest that they are distracted by a near-human approach. When humans pick

up poultry, they can struggle but sometimes hang limply and, if put down, display a freezing reaction (Broom, 2000). The behavioural reaction to being grabbed and held is usually that of passive panic behaviour, this is not understood by those who interact with them as reflecting a significant disruption they are exposed to by physiological measures.

Procedures and Preparations before Loading Animals for Transport

Pre-transport Inspection

Livestock should be examined pre, during, and post transport. Livestock to be transported may be unsuited for the journey due to injury or illness, or they may be transported only under circumstances that are prescribed by law to be minimum. A post-mortem examination is performed when animals transported for slaughter arrive at an abattoir. Judgments about disease conditions require veterinary expertise at either of these times. Border crossing inspectors, police, or inspectors of animal protection societies may also inspect road vehicles carrying livestock to check for the design of vehicles, animals' condition, or other adherence to legal requirements. Nonetheless, the majority of pre transport checks on livestock are performed by the animal health officials in charge of the animals at the place of departure. The livestock examination process includes physical observation and knowledge of auditory and olfactory signals that indicate that animals are suffering challenges. It is appropriate for every animal to be seen; this must be made possible by the design of trucks, the orientation of livestock in the truck, and the stocking rate.

Loading

Several studies have shown that one major distressing aspect of transporting livestock is loading and unloading (Hall & Bradshaw, 1998). Most physiological alterations suggestive of stress occur during loading and after initial few hours in transit. Then, as the animals become accustomed to transport, the stress response gradually disappears. As a result, the major welfare issues created by transportation are caused by loading, granted that the transport circumstances are good and the trip is not long. (Broom, Goode, Hall, Lloyd, & Parrott, 1996; Knowles *et al.*, 1995). The significant impact that loading can have on the animals' welfare stems from a mixture of multiple stressors that affect welfare of livestock. A few of these stressors are being forced to physical exercise as animals move into the truck. When animals have to climb high ramps, physical exertion is especially significant. Second, the novelty of being relocated into obscure surroundings causes psychological stress. Integrating unfamiliar animals also contribute to increased aggression, causing stress in return in pigs and cattle (Tan and Shackleton, 1990; Mench, Swanson & Stricklin, 1990). Loading also necessitates close contact with humans, which might be frightening to animals who are not used to it. Ultimately, pain can result from mishandling of animals during loading. Using a stick to beat or prod animals may result in injury and pain, particularly in vulnerable parts like the eyes, ano-genital area, mouth or belly, and grabbing sheep by the wool may inflict pain (Knowles *et al.*, 1994). The use of electrical goads will also be painful.

There are significant differences in how different species react to handling and loading, and these differences should be taken into account when

choosing acceptable loading strategies. In negotiating steep ramps, swine, for example, suffer greater challenges than lambs or cattle. According to Manteca and Ruiz-de-la-Torre (1999) sheep do not fight when they are combined with new animals, while social mixing in pigs and cattle can be a severe problem (Tan & Shackleton, 1990; Mench *et al.*, 1990). Disparities among individuals of the same species are also found. Transportation experience is essential. At repeated loadings in livestock, animals who have previously been put into a vehicle show a far less significant response than those who have never been loaded (Fernandez-Diaz, 1990).

Space Requirements

Amongst the most important elements affecting an animal's well-being during transportation is the number of animals involved (Hall & Bradshaw, 1998). Moreover, since it is possible to save costs by lowering space requirement to accommodate more animals on to a truck, the matter is sensitive. In simple words, reduced room sizes contribute to lower transportation cost as it is possible to carry more animals in a truck of any specific dimension. There are two components to space allowances. The first element is the available floor space for the livestock to either stand or lie down. It correlates to what is typically known as loading density. The height of the compartment in which the animal is being transported is the second important aspect. Physical measurements of the animals determine minimum acceptable space allowances. However, the minimum suitable allowances would also rely on other variables. Examples include the animals' ability to efficiently regulate their body to adapt to the environmental conditions, notably the atmospheric humidity, and space provided for the livestock to

sleep if they prefer to. Whether the animals choose to lie down or not can depend on the duration of the journey, the conditions of transport, mainly whether it is comfortable to do so, and the care taken in driving the vehicle and its suspension characteristics to the nature of the road surface. A very critical factor in the concept of realistic minimum space specifications is whether the animals need to be laid down, watered, and fed on the vehicle. Relaxation, watering, and feeding in the vehicle would require a lower stocking density to give the animals access to food and water. The determination of appropriate minimum permissible space allowances for transported animals is based on many facts. These include evidence-based first guidelines using measures of animals' dimensions, evidence related to behavioural assessments of animals under actual or simulated transport conditions and evidence-based on measurements of indices of adverse transport effects. An example of the above form of proof will be carcass bruising or the enzyme activity such as creatine kinase (CK) in the blood.

The European Commission Directive 91/628 established the rule that livestock ought to have enough room to stand or lie down in positions that are natural to maintain thermal satisfaction and prevent pain or discomfort, as well as the space allowance and height of the vehicle for average weight and various groups of species.

Vehicle Design and Quality Features

Atkinson (1992) stated that the design of animal transport trucks differs by country, depending on what is feasible to that nation. The European Union's assessment of the conditions of swine transport reported that the overall design of animal transport trucks in many countries was relatively

constant. However, it varied between countries that were mainly climate-influenced (Christensen, Barton Gade and Blaabjerg, 1994); and it does not seem impossible that there would be a similar condition for cattle transport trucks. In groups (normally between four and eight animals), transported cattle can be penned or haltered separately. Single confining or haltering avoids fighting or other defensive interactions, especially if they are not familiar animals and perhaps gathered from various rearing farms. For young bulls, this is particularly true. The difficulty with single haltering is that it is critical to avoid encounters, and the halter rope needs to be short to avoid entanglement. Nevertheless, if it falls, short ropes can hinder the animals' ability to lie down, and may even be hazardous to it.

Road Conditions

There are several other variables besides the design and equipment of vehicles, which can significantly affect travel comfort, including road type, road surface, windy roads, traffic density, and situations of irregular movement. The driver must have a high level of knowledge in order to have a substantial impact on the livestock's welfare by driving cautiously and utilizing quiet roads that are least vulnerable to road traffic. Cattle start lying down following four to five hours of calm driving. The animals will instantly stand up again whenever the brakes are employed repeatedly, accompanied by rapid acceleration or quick turns. In pigs, it has been shown that the type and condition of the road surface can reflect the heart frequency curve of the transported animals (Steffens, 1999). For cattle, similar findings may be valid.

Driving Quality

According to Christensen and Barton Gade (1996), incidents during transport, such as abrupt acceleration and brakes, navigating roundabouts, led to short-term heart rate increases in livestock. Bradshaw *et al.* (1996a) found that after packing, plasma cortisol levels escalated in livestock and stayed higher for rough rather than smooth trips, for a more extended period. It should be noticed that the work of Bradshaw was not performed under commercial conditions. There were small pig groups, wide room allowances (0.49 m² per 90 kg pig), and a semi-laden truck. It was a commercial truck, but its vibration features were not ideal, like many of them (Randall *et al.*, 1996). Although it is not always possible to choose the sort of road you take, it is possible to optimize the way drivers brake, navigate bends and roundabouts. All drivers qualified for animal transport must have undertaken a training course and earned a certificate of professionalism, unless they can show that they have extensive experience and demonstrate their understanding of the needs of animals.

Long Distance Transport of Livestock

The majority of long-distance transport challenges occur prior to the start of the actual journey. Animals are normally transported to collection points in smaller trucks. Practices such as loading and unloading, accompanied by grouping with unfamiliar animals are challenging. As mentioned by several authors, remixing, in particular, represents a stressful activity for livestock that have never been handled by humans in such manner (Kenny & Tarrant, 1987; Lensink, Raussi, Boivin, Pykkönen & Veissier, 2001). In comparison, for adult cattle, the ramp structure and the loading itself are minor challenges

(Tarrant, 1990). In a variety of studies on the impact of duration of travel the majority of authors point out that animals' detrimental effects are also increased with an increasing travel period, as represented by different physiological variables like body weight, Creatine Kinase (CK), Beta-Hydroxybutyrate (BHB), total protein, and Non-Esterified Fatty Acid (NEFA). Fourteen hours of lack of food and water results in vigorous attempts to obtain food and water as the opportunity occurs, but deprivation must be 24 hours before changes in the physiology of calcium, phosphate, potassium, sodium, osmolarity, and urea occur in the blood (Chupin, Sarignac, Aupiais & Lucbert, 2000). However, food and water deprivation along the journey is expected to have significant and more rapid consequences. When cattle were transported for two consecutive 29-hour journeys, with a 24-hour rest time between them, the extent of the energy deficit was quantified by Hartung *et al.*, (2000). The laws require a break of at least one hour for the animals' feeding and watering, after 14 hours of transport. Many studies have found that because one hour does not give ruminants' ample time for enough food and water consumption, the journey's overall length is also prolonged (Knowles *et al.*, 1997). At least 24 hours break is expected after 29 hours of traveling, with the animals being unloaded into a rest station. Studies by Knowles *et al.* (1999) show that, after 24 hours of recovery, most physiological parameters returned to pre-transport values. These breaks, however, significantly extend the overall travel time making it inconvenient and more expensive for operators.

Staging Points or Rest Stops

A staging point or rest stop is a place where livestock are offloaded, fed watered and allowed a time of rest for at least 24 hours when the animals

have travelled more than 8 hours according to the Council Regulation (EC) No. 1255/97 (criteria for staging points and route plan). This is important in the transport of live animals because it allows the animals to recover from stress before proceeding on their journey.

The criteria for staging posts are governed the by EU Directive 1255/97. It requires regulations on sanitation and disinfection of the facilities, proper feeding and watering of the animals, and the provision that the facilities must be built to ensure that different animals are not remixed and that trained workers must be present. It is also necessary that the facilities be designed to conform to the variety of animals located there, as the animals can range from young calves to adult bulls to dairy cows, so that each of their needs can be fulfilled.

For instance, bulls in a larger group put in a pen without facilities to deter them from mounting are not more likely to partake in physical exercise with minimal rest period. Among other things, violent behaviour is affected by group size and stock density (Tennessee, Price & Berg, 1984). Researches have shown that female cattle that were not unloaded during the rest time, but kept in a stationary truck during those 24 hours, had better resting values than those that were unloaded and reloaded, given that the loading densities were not too large (Hartung *et al.*, 2000).

Travel Time

A series of related and repeatedly occurring stressors of a mechanical, climatic, acoustical, nutritional, or social disposition are introduced to animals during transport. Together, or as single incidents, these factors may interact. The majority of livestock transport investigations relate to journeys of few

hours to 24 hours. Locatelli, Sartorelli, Agnes, Bondiolotti and Picotti (1989) collected blood samples from calves before and during journeys. Forty-eight hours to find changes in the components of the blood that may indicate stress. One of the parameters that are most commonly measured is cortisol. After loading and within the first few hours of the ride, the largest concentrations are commonly observed (Kenny & Tarrant, 1987; Kent & Ewbank, 1986). Long distance travel results in a gradual loss of body and carcass weight, with the latter providing a clearer indicator of how much the livestock deplete their body reserves (Knowles, 1999). After 15 hours of transport, liveweight loss was confirmed to be 5.5-6 percent (Broom *et al.*, 1996; Knowles *et al.*, 1996) and 7-8 percent after 24 hours of transport (Broom *et al.*, 1996).

Welfare at Livestock Market

When animals are sold through livestock markets, tracing meat back to the farm of origin is difficult. The fear is that it will be difficult to ascertain the source of the issue when there is a food safety threat, such as bovine spongiform encephalopathy (BSE). In countries with adopted cattle passports, that concern is no longer valid, as passports now permit an acceptable degree of traceability. Instead, this issue has been replaced by concerns regarding disease transmission within markets. Science-based risk analysis supports this and especially applies to exotic infectious diseases (Robinson & Christley, 2007). However, transhumance is potentially a higher disease risk in Africa than selling animals in the market (Bronsvort *et al.*, 2004).

The third issue about the livestock market is its effect on the hygiene of animals. Selling cattle through the open market can spike the risk of infection by harmful bacteria (Collis *et al.*, 2004).

The fourth issue is that in contrast to animals supplied directly to slaughterhouses, the welfare of livestock sold through markets is poor (Murray, Davies, Cullinane, Eddison & Kirk, 2000). Exhaustion, fear and discomfort, fasting, dehydration, and injuries are the welfare issues for putting cattle through markets. It is well established that the incidence of carcass bruising is greater in cattle sold through markets than in cattle sold directly to slaughterhouses, and this is cited as proof that auction marketing is less acceptable than direct sales to slaughterhouses (Weeks *et al.*, 2002).

Lairage Assessment and Time of Holding

Upon arrival at the slaughterhouse, preferably, all animals rest in the lairage. This helps them to recover from transportation stressors and serves as a buffer for the pre-slaughter process. Duration for lairage is part of pre-slaughter processes and is combined with a range of stress problems that influence farm animals (Velarde & Dalmau, 2012). Some researchers have found that prolonged lairage causes a detrimental effect on meat quality (Amtmann, Gallo, Van Schaik & Tadich, 2006). Most global bodies also request that all farm animals be slaughtered shortly after they arrive at the slaughterhouse (OIE, 2009).

On the contrary, other writers have stated that longer lairage time helps cattle to recover with a positive influence on the process of meat acidification from transport stress (Del Campo, Brito, De Lima, Hernández & Montossi, 2010). The maintenance of low levels of stress in live animals is a significant welfare issue; moreover, it also has a beneficial impact on meat quality (Purnell, 2013). Livestock should not be integrated with unfamiliar animals during transport and in lairages to prevent fighting and bruising. The lairage

structure should be designed, built, and maintained to avoid physical injury to the animals and allow sufficient ventilation, illumination and protection from adverse weather conditions. The lairage space allowance should permit all animals to concurrently stand or sit or lay down (Channon, 2014). Therefore, it is necessary to limit the flow of waste water, faeces, and other debris so that the clean area is not contaminated. Furthermore, workers should not be permitted to move straight from the lairage to other areas of the slaughtering facility. Consequently, the entire lairage area should be kept as clean and, mainly dry, as possible (Tinker & Burton, 2005).

Stunning of animals prior to slaughter

Animals are restrained in a stunning box as the slaughter operation commences, limiting their bodily movement. After being restrained, the livestock is stunned to ensure a painless death. Stunning is designed to make slaughter animals oblivious and insensible to pain, without halting the heart to permit complete blood loss. Stunning thus reduces the animal's discomfort and improves the meat quality (Silveira, Silveira, & Beraquet, 1998). Mechanical, electrical, and carbon dioxide (CO₂) gas are the most prevalent types of stunning practices. Each procedure has the same outcome: the animal is rendered unconscious. A pneumatic device or gun is used to fire a bolt through the animal's skull, which is known as mechanical stunning. Electrical stunning involves passing an electrical current into the animal's brain. Carbon dioxide stunning involves exposing the animal to a CO₂ gas mixture that serves as an anaesthetic (Grandin, 2015). The stunning approach differs between species. For bigger domesticated animals, for example cattle, physical techniques such as a captive bolt or non-penetrative concussive stunning are

utilized, while electrical stunner or carbon dioxide (CO₂) is utilized for pigs and poultry (Matarneh, England, Scheffler & Gerrard, 2017).

Mechanical Stunning (Captive Bolt Stunner)

A captive bolt stunner is a device utilized for stunning livestock prior to slaughter. A thick rod made of non-corrosive alloys, like stainless steel, makes up the bolt. Rubber washers are used to keep it in place within the stunner barrel. In a well-maintained stunner, the bolt is commonly not visible. The retractable rod in a penetrating captive bolt gun penetrates and causes significant physical brain damage. When used properly, a penetrating captive bolt can trigger immediate unconsciousness because visual abilities are removed from the brain (Daly, Kallweit & Ellendorf, 1988). This shows that the brain is completely unresponsive to a flash of light in the eyes. The bolt should have adequate bolt momentum to induce a significant disruption in relation to brain penetration to effectively produce immediate unconsciousness (Daly & Whittington, 1989). The captive bolt is the most adaptable stunning device because it can be used on all species of livestock (cattle, pigs, sheep and goats, as well as horses), and it can even be used in places where there is no electricity. According to Daly, Gregory and Wotton (1987), the recommended bolt velocity for steers and bulls are 55 and 70 meters per second respectively. Captive bolt stunners should be positioned at the right place on the livestock's forehead for an accurate and successful shot. The frontal location on the forehead is more effective in cattle (Gregory and Grandin, 2007). It's important to avoid firing to the back of the neck, as this doesn't always result in unconsciousness (Lambooy, & Spanjaard, 1981).

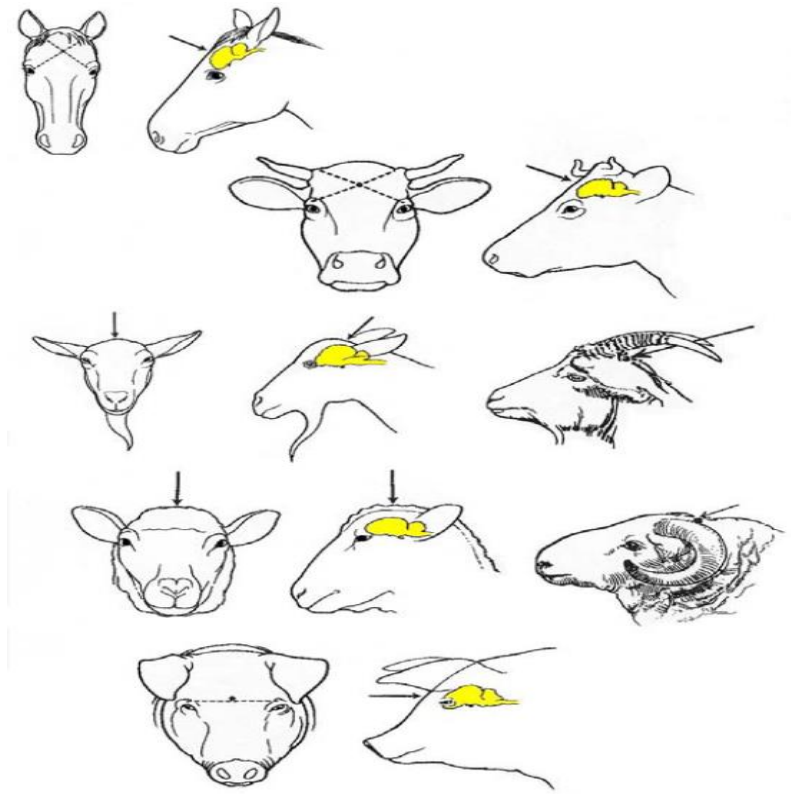


Figure 1: Right placement of captive bolt stunner for different animals (cattle, goat, horse, pig and sheep) Source: Heinz and Srisuvan (2001).

Causes of Captive Bolt Failure

Four common reasons why captive bolt fails to render livestock unconscious with a single shot are: (i) zero servicing (ii) captive bolts with damp cartridges, (iii) pneumatic captive bolt that has minimal air pressure, or (iv) aggressive animals that make placing the stunner difficult. The most common cause of captive bolt failure, according to a study of ten cattle slaughter houses, is absence of regular maintenance (Grandin, 1998b). All parts must be cleaned and replaced according to the manufacturer's directions.

Evaluating the Effectiveness of Captive Bolt Stunning in Commercial Abattoirs

The percentage of livestock made fully unconscious with one shot can be used to determine the effectiveness of captive bolt stunning. About 95 percent of livestock rendered unconscious with one shot is an acceptable result, and 99 percent of livestock rendered unconscious with a single shot is an outstanding score, according to the voluntary industry standard (Scott, 2018). The average percentage of cattle made insensible with only one shot was 97 percent, according to data taken in sixty-six cattle slaughter / processing plants (Grandin, 2005). A head restraint was not used by any of the plants. Any livestock that requires a second attempt must be shot as quickly as possible to avoid unnecessary pain. For any animal which shows evidence of regaining sensibility, hoisting or beginning dressing activities such as skinning is not acceptable. In two experiments, it was discovered that the use of captive bolt to cause unconsciousness in bulls and livestock with large heads, with only one shot, was a challenge (Grandin, 2002). A huge-caliber firearm that does not require bullets has been used by some plants to solve this issue. This is effective, according to the author; however, there are some safety problems. Post-stunning kicking with the hind limb is a safety threat for commercial slaughterhouse workers. Cattle that are effectively stunned and insentient may still kick and lift their hind limbs (Kline, Wagner, Edwards-Callaway, Alexander & Grandin 2019). Other than data collected in 2010, all of the studies were performed before the advent of modern, more efficient captive bolt devices, such as the Jarvis Pneumatic. Most big abattoirs with a centre-track conveyor restrainer use the Jarvis Pneumatic.

According to Grandin (2002) the Jarvis Pneumatic is by far more powerful than most captive bolt stunners that use cartridges or air pressure. It is recommended that because of its weight and bulkiness, the Jarvis Pneumatic requires head restraint when utilized in a standard stun cage. Most plants give extra "insurance" shots to ensure that an animal remains insentient. It is an excellent exercise that will benefit animals. When assessing captive bolt stunning, the examiner or inspector should check the animal for unconsciousness prior to administering the second stun. With just one shot, the plant ought to achieve immediate unconsciousness in 95 percent or more of carcass.

Electric Stunning

Electrical stunning refers to the process of passing an electric current through an animal's brain and/or heart prior to slaughter. A current flowing through the brain causes an instantaneous yet non-fatal general seizure, resulting in unconsciousness. As current passes through the heart, it causes cardiac arrest, which is followed by loss of consciousness. Electric stunning causes a brain seizure, which results in instant insensibility (Croft, 1952). The electrodes should be positioned in such a way that the voltage flows through the brain to effectively cause a seizure (Anil & McKinstry, 1998). Electrical stunning requires a minimum of 1 amp, 1.25 amps, and 1.5 amps for sheep, pigs and cattle respectively (OIE, 2009). While certain pigs were not made unconscious at the prescribed amperages, it is suggested to use other outcome indicators such as signals of regaining consciousness, according to a study conducted in four pig slaughter plants (Végh, Abonyi-Tóth & Rafai, 2010). The normal 50- or 60-cycle current remains the most efficient frequency; the

use of high frequencies such as 2000 and 3000 hz are ineffective (Warrington, 1974). Small pigs will become unconscious to a frequency of 1642 Hz square wave or of 1592 Hz sine wave, but the time of unconsciousness will be reduced. It is efficient to introduce 800 hz to the brain, proceeded by a 50 hz electrical current to the body. Higher frequencies minimize blood spots in the meat; hence slaughterhouse operators are also tempted to use them (Anil & McKinstry, 1992).

Types of Electrical Stunning

Electric stunning can be accomplished in three ways; head-to-body cardiac arrest, head-only reversible, and head-only with a current placed on the body to stop the heart are the three types.

The effect of a head-only stun is only brief. Therefore, to avoid regain of consciousness and full recovery, the animal ought to be bled immediately. It is strongly advised that bleeding is done within 15 seconds of removing the head-only stunner (Blackmore & Newhook, 1981).

After being stunned just on the head for 30 seconds, animals can regain their senses (Hoenderken, 1983). Many small slaughter plants use head-only electrical stunning on sheep and pigs. Prior to bleeding, the author has encountered issues with animals regaining their senses. This is due to using a sluggish hoist to raise the animals after they have been stunned. Cardiac arrest can be quickly accomplished by placing the stunning tongs to the side of the body again, right after the head stun, to avoid the regain of consciousness (Vogel, Badtram, Claus, Grandin, Turpin, Weyker & Voogd, 2011). This is a simple solution to a serious animal welfare issue that requires no extra equipment. The electrode is placed directly behind the foreleg to

avoid meat quality issues. Slaughter halls in New Zealand also employ head-only stunning before halal (Muslim) slaughter (Grandin, 2015). Since it is totally reversible and hence, the animal dies as a result of exsanguination during slaughter, most Muslim religious leaders will permit electric head-only stunning. They have high-speed, costly equipment that allows exsanguination to occur in less than 10 seconds.

The majority of large pork and sheep plants in the United States use head-to-body cardiac arrest stunning. This procedure involves simultaneously transmitting current through the heart and brain to cause cardiac arrest and instant unconsciousness (Lambooy & Spanjaard, 1982). In big slaughter plants, wrong positioning of electrodes and poor bleeding are the most prevalent causes of regaining consciousness following cardiac arrest electric stunning (Grandin, 2001b). By paying close attention to aspects like electrode positioning, the majority of electrical stunning challenges can be efficiently corrected.

Electric Stunning Quality Control

A tonic (rigid) and clonic (leg-paddling) process must be accurately induced by an electric stunner, indicating that an insensibility was induced. Before the electric stunner can be used, the electrodes must be tightly attached to the head. A pig will squeal briefly if the tongs are energized before firm contact is made, indicating pain. When the electrodes are not tightly pressed against the head, a minimal voltage flows when the electrode first touches the animal, according to a study conducted with an oscilloscope (Gregory & Grandin, 2007). The whole current passes through the animal when the electrode is tightly placed. When the stunner was employed in ten out of

seventeen plants where swine were restrained in a V conveyor restrainer, none of the swine squealed (Grandin, 2001a).

Carbon dioxide (CO₂) Stunning

Carbon dioxide stunning is the act of stunning animals commercially by being subjected to higher concentrations of carbon dioxide (>80% by volume in air), resulting in a progressive unconsciousness (Verhoeven, Gerritzen, Velarde, Hellebrekers & Kemp, 2016). CO₂ gas stunning has many advantages over electrical stunning, such as the opportunity to stun animals in groups with limited restraint, minimal handling, and therefore potentially decreased stress prior to stunning. In comparison to electrical stunning, CO₂ has been shown to increase meat and carcass quality (Channon, Payne & Warner, 2003). However, CO₂ gas stunning does not render immediate insensibility as captive bolt or electric stunning. High-concentration carbon dioxide stunning has been linked to a variety of welfare problems in recent studies. Pigs are extremely aversive (very uncomfortable, painful) to concentrations greater than 30%. CO₂ is highly aversive to pigs, according to some experts, because the excitation process happens before the pigs lose their consciousness (Rodríguez *et al.*, 2008). Practically, different amounts of CO₂ in the air are used to stun animals. According to Grandin (1998a), pigs must be stunned at a carbon dioxide concentration of at maximum 80 percent in the air for 45 seconds, and poultry must be stunned at a carbon dioxide concentration of minimum 65 percent in the air for 15 seconds. However, the acceptability methods in terms of welfare have been a challenge. It may be suitable for certain genetic groups of pigs, but it may be stressful for others. From a welfare standpoint, the author suggests that the best approach to

examine a gas stunning technique is to monitor the livestock's reaction when it is initially exposed to the gas. Efforts to flee the chamber violently until the animal drops over (loses posture) and becomes unconscious are evidently unacceptable. It's likely that using a mixture of CO₂ and argon would make CO₂ stunning less painful for pigs with CO₂ sensitivity.

On the issue of stunning prior to slaughter, legislations have been put in place in most developed countries, requiring all animals to be stunned before neck incision. In several European countries such as Belgium, the United Kingdom, France, Germany, and the Netherlands, animal welfare regulations mandate that all livestock, except for religious slaughter, must be made unconscious before slaughter (Bonne & Verbeke, 2008).

Influence of stunning on consumer purchasing decisions

The method of slaughter is an important purchasing decision for most halal consumers. According to Lever & Miele (2012), the consumption of meat from pre-stunned animals is linked with a great deal of societal and demographic factors. Fuseini and Knowles (2020) surveyed English halal meat consumers to examine their preference for livestock slaughtered meat according to different slaughter protocols. The authors reported that most respondents (69%) indicated a preference for meat from animals slaughtered without stunning. Uzunöz and Karakaş (2014) revealed that education, income, household size, and gender were the factors that significantly influenced the consumption of red meat in Turkey; this is consistent with the findings of Fuseini and Sulemana (2018), in a study involving Ghanaian meat consumers. Likewise, McLean-Meynsse, Hui and Meynsse (1996) showed that important demographic factors such as religion and race played an

essential role in meat consumption. Health and safety concerns have also been reported to influence the purchase of meat and meat products (Makanyeza & Du Toit, 2016). On the contrary, in France, most Muslims (84%) always eat the meat of pre-stunned animals (Bonne & Verbeke, 2008). Ibrahim (2011) conducted a study on consumers' willingness to pay premium prices for halal goat meat in Atlanta, Georgia which revealed that income, household size, current consumption, and marital status significantly influenced a higher premium for halal goat meat. In a study investigating the effect of attitude on animals' welfare on the consumption of meat in Ghana, Fuseini and Sulemana (2018) observed that animal welfare indices such as production system, humaneness of slaughter, and transport system significantly influenced the consumption of meat.

The demand for pre-stunned meat is increasing among Muslims, and it is projected to have a continual exponential increase (Regenstein, Chaudry & Regenstein, 2003). A differing number of factors could contribute to the continuous demand for pre-stunned meat among Muslims. Notable among these factors include the study of Bonne, Vermeir and Verbeke (2008) on the impact of religion on halal meat consumption in Belgium. The study's findings revealed that devoted Muslims frequently consumed halal meat because they perceive it to be healthy. A review study by Bonne *et al.* (2008) found that Muslims who were given preliminary information on halal were more particular about the halal food and information on the product label than individuals who had no information about halal.

Also, Bonne and Verbeke (2008) conducted a critical review of halal meat production in Belgium. The authors found that Muslims preferred buying

meat of pre-stunned animals from Muslim butchers, especially when the butcher has a domicile origin from the buyer's home country. Using the Cragg Double Hurdle Model, Karli and Bilgic (2007) found that the demand for white meat was not influenced by age, total food expenditure, and household size. Uzunöz and Karakaş (2014) revealed that household size and education were negatively significant in influencing the consumption of red meat in Turkey. Similarly, Uzmay and Cinar (2017) revealed that stunning which reduced pain and suffering of livestock positively influenced the purchase of stunned meat among Muslims in Turkey.

Theories of Islam on the consumption of meat of stunned animals

Muslims derive their dietary rules from mainly the Quran and Hadith. Every practicing Muslim is enjoined to follow these rules. They are seen to be direct commandments of God because some of the rules originate from the Quran. Halal is an Arabic term that means anything permissible, the opposite of halal being *haram*. When used for meat, halal meat is derived from animals slaughtered per Islamic customs; that is, the name of Allah (God) must be recited at the point of slaughter, and animals must be slaughtered while they are alive (not necessarily conscious). It further explained that only God is capable of deciding what is permissible or not, and these prohibitions are clearly outlined in the Quran. In his book on animal welfare in Islam, Masri (2016) suggested that most Muslims have a good understanding of halal meat production rules. However, there has been debate in recent decades surrounding the acceptability of some slaughter procedures. Fuseini, Wotton, Hadley and Knowles (2017a) conducted an extensive review of halal meat production aspects that have divided Islamic scholarly opinion. The authors

identified the following as the main aspects of slaughter that continue to divide scholarly opinion; pre-slaughter stunning, mechanical slaughter (of poultry), and thoracic sticking (mainly of large animals).

Despite the debate surrounding the acceptability of stunning for halal meat production, most halal meat produced in the industrialised world is from animals that have been stunned prior to slaughter (Fuseini, Wotton, Hadley and Knowles (2017b)). The acceptability of stunning for halal meat production is based on several conditions:

1. The stunning method should not lead to the death of the animal (Farouk, Pufpaff & Amir, 2016).
2. The volume and efficiency of blood loss should not be obstructed; this is because Muslims are prohibited from consuming blood
3. The method of stunning should not compromise the welfare of the animal
4. The method of stunning should not negatively impact carcass and meat quality.

Opponents of halal stunning believe that pre-slaughter stunning is alien to Islamic customs because the Prophet of Islam did not practice stunning and that it is not mentioned anywhere in the Quran. It is worth mentioning that when the religious scriptures were revealed, stunning had not been discovered. Fuseini *et al.* (2017b) suggested a dialogue between religious authorities and animal welfare scientists so that the different stunning methods could be explained to Islamic scholars to enable them to make informed decisions on which methods are acceptable (or otherwise).

Summary

Farmed animals pass through three distinct stages in their lives, namely, production, transport and slaughter. Farm animals are subject to human imposed constraints and for a very long time the choice of techniques has been based primarily on the efficiency of production. However, it is an increasingly held view that we should protect those animals against maltreatment, or allow them the maximum of good welfare. In order to safeguard welfare and avoid suffering, a wide range of needs must be fulfilled. This was a tremendous success and points the way towards further thought and research into animal welfare, training of drivers, stockmen and butchers, assessment of competence, raising of welfare standards worldwide, and understanding the importance of this issue to producers and consumers alike. Producers must understand that animal welfare can be entirely to their benefit rather than a perceived threat. Consumers need to understand the efforts that producers are putting into raising animal welfare standards throughout the production cycle. It is not just good welfare; it is good economics.

CHAPTER THREE

METHODOLOGY

Introduction

The research methodology used in this study is described in this chapter. It covers the research area, selected research approach, details of the methods and instruments used for data collection, target population, sampling techniques, coding, and data analysis.

Study Areas

A report by Addo *et al.* (2011) estimated that Ghana has a cattle population of less than 1.30 million, and as a result, cattle slaughtered in the country are mostly obtained from neighbouring states such as Côte d'Ivoire, Burkina Faso, Togo, Niger and Mali by traders, to supplement the domestic supply of livestock in Ghana.

Three government-approved abattoir/slaughterhouses were selected for the current study from Cape Coast, Kumasi, and Tamale, representing the coastal, middle, and northern sectors of Ghana.

The Cape Coast Metropolis occupies a land area of 122 km²; batholiths interspersed by valleys dominate the topography of the Cape Coast Municipality. It is located on longitude 1° 15' W and latitude 5°06' N. The area is found in Ghana's anomalous coastal zone, which makes the city experience extreme temperatures all year round. The Cape Coast Metropolis has a settlement population of 143, 015 people as per the 2010 census (GSS, 2021).

Kumasi, with a land area of 250 square kilometres (km²), is situated in the transitional forest zone of Ghana, and lies about 270 km north-west of Accra, the capital of Ghana, as shown in Figure. 2. It is the Ashanti region's

capital and has centrality as a navigating point from all parts of the country, which made it a significant business community. The strategic location of Kumasi makes it a significant destination for migrants from across the country and beyond. The city presently hosts nearly 68% of the Ashanti region's populace, of about one million, four hundred and sixty eight thousand, six hundred and nine (1,468,609). Maoulidi (2010) reported that Kumasi has an estimated annual growth rate of 5.4%, the fastest in Ghana, far above the annual national and regional growth rates of 2.4 and 2.6 % respectively (GSS, 2011).

The city of Tamale is the capital of Ghana's northern region. It began as a development centre in northern Ghana and has since grown to become the country's third most significant urban city. The city has the second most noteworthy population growth rate after the Kumasi Metropolis (GSS, 2011). Tamale is located within latitude $9^{\circ}16'N$ and $9^{\circ}34'N$ longitude $0^{\circ}34'N$ and $0^{\circ}57'W$. The city covers a landmass of 922km^2 (Tamale Metropolitan Assembly, 2010).

Figure 2 indicates the selected locations for the study.



Figure 2: Political Map of Ghana.

Source: <https://worldpopulationreview.com/countries/cities/ghana>

Research Design

A descriptive study was selected because the research problems do not lend easily to an experimental one i.e., human characteristics and behaviour are inherently not subject to experimental manipulation.

Study Population and Data Collection Methods

The study population consisted of drivers of trucks used in transporting livestock, livestock owners/caretakers, butchers from selected abattoirs, some Islamic scholars, and selected meat consumers. Interviews, questionnaires, and observation of activities were used in the data collection.

Transport facilities and Drivers

The researcher gathered data on the types and condition of vehicles used in transporting livestock, general conditions under which livestock were transported. A total of fifty drivers of trucks used in transporting livestock were interviewed to find out the sources of livestock, the distances covered to the abattoir or livestock market, animal welfare considerations in transit, type of document carried along when transporting animals, and the extent of mortality encountered in transit. In addition to interviews and questionnaires administered, field observations were made to gather additional information. In order to assess the condition of trucks used for animal transport features such as trucks showing no side walls, no roof covering, presence of sharp protrusions or broken floors that could injure animals; presence of bedding material to prevent slippage; a ramp for loading or unloading animals, and presence of individual compartments in truck were considered and Ranked. Ranking was done based on the number of positive features present on the vehicle. Rank scores between 1-2, 3-4, and 5-6 were interpreted to be bad,

good and very good respectively, and these ranks were converted into percentages.

Cattle vendors / Marketing

In addition, 40 livestock vendors were identified and interviewed on welfare practices at the Kumasi Livestock Market. Information was gathered on where animals were kept on arrival; availability and type of shelter for animals; provision of feed and the kind of feed given (if applicable), provision and source of drinking water (if applicable); percentage mortality (if any); the maximum period of stay for animals in the market; and whether or not vendors have had any training on proper livestock handling practices.

Butchers

A total of six butchers (heads of operations, 2 each from the Cattle and Pig Units at the Kumasi abattoir; and 1 each from the UCC and Cape Coast Metro slaughterhouse) who had received previous training and had been supplied with captive bolt stunners were interviewed. This was to find out the benefits derived from using the stunners, and challenges they encountered.

Meat consumers

This aspect of the study involved 170 meat consumers and 19 Islamic scholars from some selected communities.

The meat consumers, on the other hand, were selected from the Ashanti Region only. This is because the Ashanti region is a cosmopolitan community, and coupled with its strategic central location, has residents from almost all region, tribes and religions in the country. A total of six towns were purposively selected for this study. (Bantama, Aboabo, Sawaba, Ahodwo, Daaban, and Santasi) based on the religious/tribal compositions of the

inhabitants (AVMA, 2013). Aboabo and Sawaba are Islamic dominated communities (Category 1); Ahodwo and Nhyiaeso are dominated by the “elite” in society (Category 2); Daaban and Santasi are dominated by indigenes of the Ashanti region with low levels of formal education (Category 3); while Bantama is dominated by non-Islamic inhabitants (Category 4). The stratified sampling method was used to select 45 households from each category. In each household, those in charge of making food purchasing decisions (as indicated by the family) were interviewed. They were requested to fill-out the content-validated questionnaires to indicate their opinion on stunning of animals prior to slaughter, and whether their meat purchasing decisions could be affected by it. A total of 45 questionnaires were distributed per category, and respondents with no formal education were assisted to fill-out the questionnaires, after translating its contents into their local languages. It was ensured that all respondents were meat consumers.

Islamic Scholars

A total of nineteen Islamic Scholars were selected from the Central Mosque Secretariats of the Northern, Ashanti and Central Regions of Ghana. The Imams at each of the Mosques appointed respondents to assist the researchers in completing the questionnaires.

Methods of Data Analysis

The descriptive statistics tool and Probit Regression Model in SPSS (version 25, 2017) were used to analyse the data in order to develop tables, frequencies and percentages. The Probit Analysis was used to determine factors that could influence consumers' willingness to purchase meat from stunned animals as it assumes that the decision of a consumer to purchase

meat from a stunned animal is dummy, involving two mutually exclusive alternatives which were then assigned values of 1 (yes) or 0 (no) (Bannor, Kumar, Oppong-Kyeremeh & Wongnaa, 2020). Accordingly, the decision to buy meat from stunned animals (1) or not (0) is dependent on several demographic, religious, meat safety, and knowledge characteristics (refer to Table 2 for details).

Suppose the probability p_i of choosing meat from a stunned animal to that of non-stunned animals depends on the level of satisfaction attained, as expressed in equation (1):

$$P_i = \text{prob}[Y_i = 1 | A] = \int_{-\infty}^{a_i \beta} (2\pi)^{-1/2} \exp\left(-\frac{l^2}{2}\right) dl \quad (1)$$

$$\phi(a_i \beta)$$

Where ϕ represents the cumulative standard normal distribution variable (Greene, 2011) and specified as follows:

Following Greene (2011) and Gujarati (2015), the interaction between a specific variable and an outcome of a probability is interpreted using marginal effect. Thus, the marginal effect is related to continuous explanatory variables a_{ik} on the probability $P(Y_i = 1 | A)$, holding the other variables constant, can be derived as follows:

$$\frac{\partial p_i}{\partial a_{ij}} = \phi(a_i \beta) \beta_{ij} \quad (2)$$

Where ϕ = probability density function of a standard normal variable.

The variables used to analyse the factors influencing consumers' decision to buy meat of stunned animals and the relevant literature supporting the various

hypotheses are shown in Table 2. It is hypothesised that several factors have varying effects (positive and negative) on the willingness to purchase meat of stunned animals.

Table 2a: Description of the explanatory variables for consumers and Islamic scholars used in the Probit Model

VARIABLE	Definition of Variables	Model 1 apriori expectations	Relevant literature
Dependent variables			
Stun Meat Patronage	Willingness to patronise meat of stunned animals		
Age	Continuous variable (In years)	+	Ibrahim, (2011); Yakaka <i>et al.</i> (2012); Fiqi & Darwanto, (2019); Karli & Bilgiç, (2007)
Gender	Dummy variable (1=Male 0=Otherwise)	+	Uzunöz & Karakaş, (2014); Anyiro, <i>et al.</i> (2013)
Marital status	Dummy variable (1=Single, 0=Otherwise)	+	Fuseini & Sulemana, (2018);Uzmay & Cinar, (2017)
Religion	Dummy variable (1=Muslim 0=Otherwise)	-	Mclean-Meyinsse <i>et al.</i> (1996)
Education Level	Continuous Variable (In years)	+	Uzunöz & Karakaş (2014); Maina & Baba, (2012)

Table 2b: Description of the explanatory variables for consumers and Islamic scholars used in the Probit Model

Stunning reduce pain	Dummy variable (1=Yes 0=Otherwise)	+	Aghwan <i>et al.</i> (2016)
Knowledge of stunning	Dummy variable (1=Yes 0=Otherwise)	+	
Source of meat	Dummy variable (1=Muslim butchers 0=Otherwise)	+	Bonne & Verbeke, (2008)
Check product label for safety	Dummy variable (1=Yes 0=No)	+	Makanyeza & Du Toit (2016); Zulfakar (2015)
Preferred meat	Dummy variable (1=Beef 0=Otherwise)	+	Garnier <i>et al.</i> (2003)
Devoted Muslim	Dummy variable (1=5 times per day use as proxy 0=Otherwise)	-	Bonne & Verbeke, (2008); Bonne <i>et al.</i> (2008)

Source: Authors' own from field data, 2019.

Model 1= consumers' willingness to buy meat of stunned animals; Model 2=Islamic scholars' willingness to buy meat of stunned animals

CHAPTER FOUR

RESULTS AND DISCUSSION

Table 3 presents the demographic characteristics of livestock truck drivers.

Table 3: Social-demographic characteristics of livestock truck drivers

Variables	Frequency	Percentages (%)
Age		
≤30	1	2
31 – 40	18	36
41 – 50	26	52
51 – 60	5	10
Highest Academic Level		
JHS	17	34
SHS	15	30
Graduate	1	2
No formal Education	17	34

Source: Field survey, Badu (2020)

A significant number of the truck drivers (52.%) were within the age group of 41-50 years, while the least (2.00%) were under ≤ 30 years. Truck drivers in the age group of 31-40 years constituted 36%; those within the age group of 51 - 60 years formed 10%. The results presented in Table 3 indicate that, to a larger extent, the transport of animals is carried out by drivers in the active age bracket.

More so, majority (56%) of them had attained some level of formal education; Junior High School (JHS), Senior High School (SHS) and Tertiary education representing 34%, 30%, and 2%, respectively. This means that comparatively few drivers (34%) had no formal education; so, the chances of accepting, adopting, and implementing new technologies, innovations, or ideas of doing things are likely to be high among these drivers.

Origin of livestock and conditions under which they are transported to Kumasi Abattoir/Livestock Market are presented in Table 4.

Table 4: Origin of livestock and conditions under which they are transported to Kumasi Abattoir/Livestock Market

Variable	Frequency	Percentage (%)
Origin of animals		
Burkina Faso	15	30
Mali	6	12
Togo	3	6
Ghana		
Ashanti Region	6	12
Northern Region	12	24
Upper East Region	6	12
Upper West Region	2	4
Time of departure		
Dawn 5:00am	4	8
Morning 6:00 -11:00am	18	36
Evening 5:00pm – 7:00pm	28	56
Stops at staggng points:		
For animals transported from neighbouring countries. (Burkina Faso, Mali, Togo)		
Yes	23	100
No	0	0
For animals transported within Ghana (Tamale, Wa, Ashanti, Bawku)		
Yes	0	0
No	27	100
If yes, how many times?		
For animals transported from neighbouring countries. (Burkina Faso, Mali, Togo)		
Once	20	87
Twice	3	13

Source: Field survey, Badu (2021)

Origin of animals brought to Kumasi Abattoir

Over 52% of the cattle transported to the Kumasi Livestock Market were sourced from within Ghana, notably, Northern (24%), Upper East (12%), Upper West (4%) and Ashanti (12%) regions. The remaining 48% originated from neighbouring countries such as Burkina Faso (30%), Mali (12%) and Togo (6%). This finding is similar to that of Frimpong *et al.* (2012) who reported that about 58% of livestock brought to the Kumasi Livestock Market were sourced from within Ghana. According to the Ministry of Food and Agriculture, (MoFA/DFID, 2002), many ruminants, especially live cattle and frozen meat, are imported into the country to augment local demand. This study confirms the report of MoFA that 48% of live cattle brought to the Kumasi Livestock Market were sourced from other West African countries.

Time of Departure

Concerning the time of departure, 8% of the drivers who transported animals from Burkina Faso, Mali, Togo, Tamale, Ashanti, Wa, and Bawku to the Kumasi Abattoir indicated that they took off at dawn (5:00 am); 36% indicated that they take off between the hours of 6:00 am – 11:00 am; while the majority (56%) said they took off at 5:00 pm from the respective places. When asked why they chose to take off at such specific times, two themes dominated; they departed at cooler hours of the day to avoid heat stress to the animals, and also, they had come to know that transporting animals at these times was best for the animals. From this study, and with regards to the reasons given above, it can be inferred that the livestock drivers complied with guidelines for humane handling, transport, and slaughter recommended by the FAO, which states that "elevated temperatures maximise the risk of heat stress

and death during transport. In the cooler hours of the day or even at night, transporting animals in vehicles is appropriate, and even very critical, especially for pigs" (Heinz & Srisuvan, 2001).

Stops at Staging Points

Whether they stop at staging points, all the drivers (100%) who transported animals from Burkina Faso, Mali and Togo to the Kumasi Abattoir indicated that they stop at these points to have the animals inspected by Animal Health Officials, get their import duty documents, and provide animals with feed and water. Whilst animals are being inspected, the drivers visit the restroom and also have meals. Drivers who usually use the staging points are mainly those who bring animals from neighbouring countries. The distance in kilometres and time in hours to transport animals from Burkina Faso, Mali, and Cote d'Ivoire to Kumasi, according to Frimpong *et al.* (2012), were (749-777km; 48 hours), (961.88km; 72 hours) and (404-450km; 48hours) respectively. However, 87 % of drivers who stop at staging points do so only once throughout the journey to the Kumasi Livestock Market, while 13% stopped twice, regardless of the number of hours spent in transit (between 24hrs – 72 hours). Transport duration is known to have direct effects on the livestock. A report by Gebresenbet *et al.* (2012) revealed that levels of plasma cortisol (stress hormone) reduced with longer duration in transit, whereas creatine kinase (CK) and lactate were significantly high ($p < 0.001$) after 6 hours of transport duration.

The EU Directive (1991) permits livestock to be transported for 8 hrs, with an hour rest at staging points. However, all the drivers (100%) who transported animals within Ghana (i.e., from Tamale, Wa, Bawku, Paga,

Ashanti region) to the Kumasi Livestock Market did not stop at staggings points and thus, travel from between 6hrs – 12hrs. A similar study by Frimpong, Gebresenbet, Bobobee, Aklaku and Hamdu (2014) indicated that 82% of cattle transporters did not use rest stops while transporting animals to Kumasi. Long hours of transporting livestock, particularly without rest, compromise the welfare of such animals given that, current EU regulations regarding animal welfare insist that no animal should travel beyond 8 hrs without rest (Gebresenbet, Bosona, Ljungberg & Aradom, 2011). Therefore, drivers who transport animals from within the borders of Ghana to the Kumasi Abattoir violate the EU regulation and therefore compromised the welfare on the animals in transit.

Table 5 presents issues of animals having access to feed and water in transit, records of mortality on arrival, and the measures put in place to stop fighting among animals among transported animals.

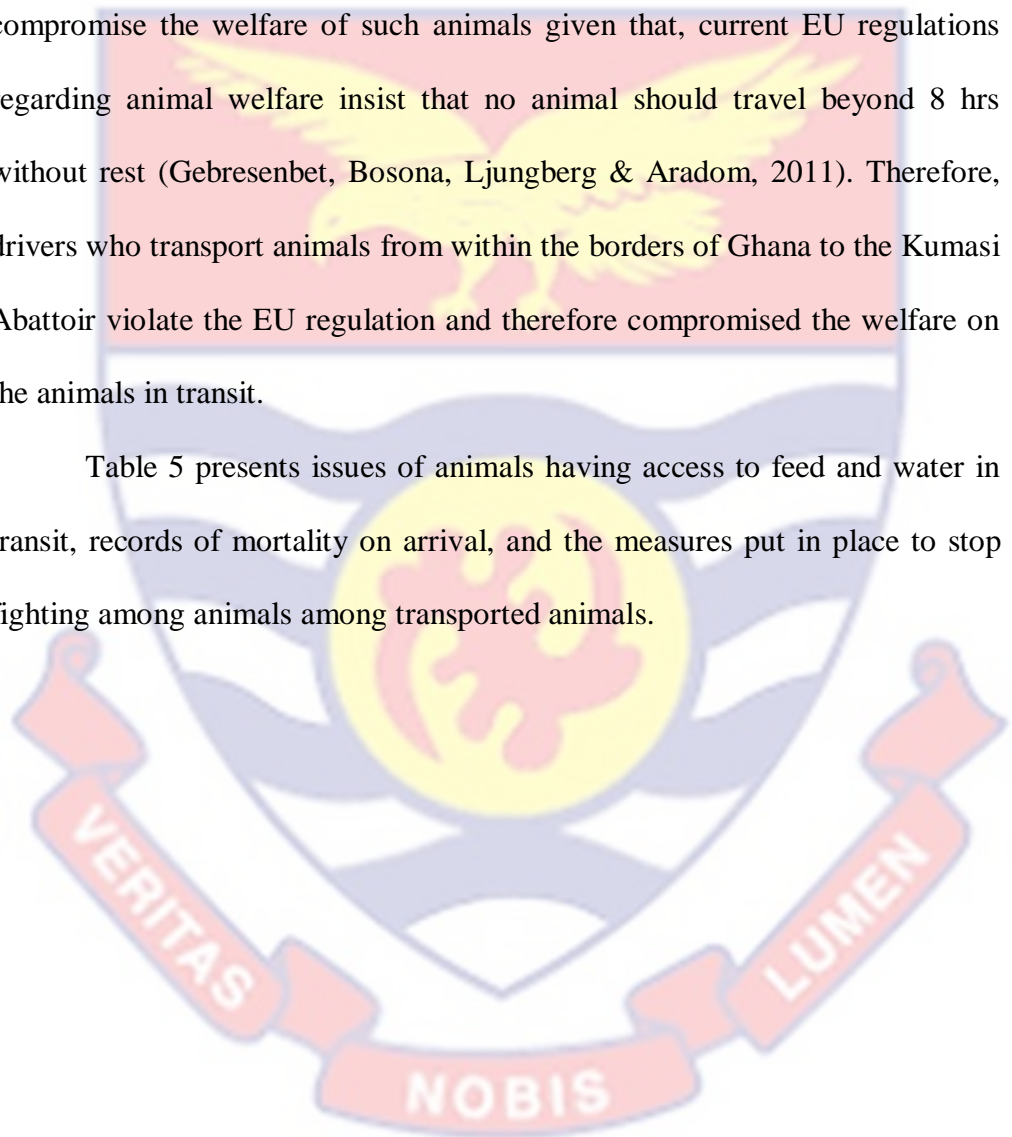


Table 5: Access to feed and water while in transit, measures to avoid fighting, and mortality issues

Variables	Frequency	Percentages (%)
Access to feed and water in transit:		
For animals transported from neighbouring countries (Burkina Faso, Mali, Togo)		
No	23	100
For animals transported from within Ghana		
Yes	2	7.4
No	25	92.6
Level of mortality on arrival:		
For animals transported from neighbouring countries (Burkina Faso, Mali, Togo)		
Yes	16	69.6
No	7	30.4
For animals transported from within Ghana (Tamale, Wa, Bawku, Ashanti)		
Yes	6	22.2
No	21	77.8
Measures to minimize fighting in transit:		
Weak and sick animals are not loaded	28	56
Give unfamiliar groups time to get used to each other	13	26
Load to the capacity of the truck	6	12
Feed animals well before loading	3	6

Source: Field survey, Badu (2021)

Feed and Water in Transit

Majority (92.6%) of the drivers who transport animals within the borders of Ghana to the Kumasi Livestock Market did not provide animals with feed and water in transit. Their reason for this is that once animals have

access to feed and water in the truck, they may lie down to regurgitate, which may cause other animals to trample on them. Also, they explained that when the animals are fed in the truck, the feeding causes production of heat, which contributes to heat stress in the truck. In this study, where only 7.4% of drivers provided feed to the animals while in transit, contradicts findings from Frimpong *et al.* (2012), which reported that 18% of hauliers provided feed to animals in transit to the Kumasi Livestock Market. Sossidou *et al.* (2009) and Gregory (2008) reported that depriving animals of feed and water leads to hunger and thirst, and undermines the welfare of animals in transit.

Mortalities

A mortality rate of 2.5% (23 dead animals out of 922 transported cattle in a month) was reported by 69.6% of drivers who transported animals from different neighbouring countries. In contrast, a mortality rate of 1.3% (8 dead out of 633 transported cattle in one month) was recorded by 22.2% of the drivers who transported animals from within regions in Ghana. Although death is a definite welfare consequence, variations in the above-stated mortality rate could probably be related to the kind of animals being transported, their transport and handling conditions and/or the duration of the journey. For instance, the distance in kilometres and time in hours to transport animals from Burkina Faso, Mali, and Cote d'Ivoire to Kumasi, according to Frimpong *et al.* (2012) are (749-777km, 48 hours), (961.88km, 72 hours) and (404-450km, 48hours) respectively, whereas it took less than 24 hours to transport animals from within Ghana to the Kumasi Livestock Market. These differences in journey lengths could account for the differences in deaths reported in this study. However, the mortality rate recorded in this study is

higher (2.5% and 1.3%) as compared to those reported in Canada of 0.011% (32 dead out of 290,866 transported cattle) as reported by González, *et al.* (2012). The Canadian animals were transported in individual compartments over 400km, which probably contributed to the relatively lower death rates. Nevertheless, Wambui, Lamuka, Karuri, Matofari and Abey (2017) reported that 6.16% of dead animals in Kenya was attributed to injuries in transit, hunger, truck accidents and mishandling by loaders. Even within the same species, the frequency of transport-related deaths differed (Grandin, McGee and Lanier, 1999). According to Nielsen, Dybkjær and Herskin (2011), mortality is mostly used as an indicator to assess animal welfare because such deaths are invariably prefaced by a time of stress and poor welfare. The use of various parameters to measure transportation issues may explain the broad differences, so this was considered. Figure 3 shows dead animals that were received on arrival at the Kumasi livestock market. When such incidents occur, carcasses are usually sent to the Kumasi Zoo to feed carnivorous animals, if post mortem examination proves that the death was not due to pathogenic diseases.



Figure 3 A and B: Cattle dead on arrival at the Kumasi Livestock Market

Measures to minimize fighting in transit

The drivers were further asked what measures they put in place to minimise fighting among animals. Majority, 56%, indicated that they avoid loading sick and weak animals on the same truck with healthy and strong animals. The transport of livestock and its guiding principles are regulated by the Council Regulations 1/2005 by the European Union, EU (1991); and it states that *"No animal shall be transported unless it is fit for the intended journey, and all animals shall be transported in conditions guaranteed not to cause injury or unnecessary suffering to them"*. Moreover, 26% of the drivers indicated that they allow unfamiliar groups to get used to each other at the collection points before loading. According to FAO (2001), pre-mixing livestock before loading will significantly minimise the risk of fighting, resulting in less injuries and stress. Therefore, in this present study, the measures taken were in line with the EU regulations.

Transport Documents

To transport animals within and across Ghana, drivers must have certain documents in their possession. All the drivers (100%) indicated that they obtained the appropriate documents for each trip. Notable among the documents are movement permit, council way-bill, import duty, certificate of inspection, and Ghana Revenue Authority's (GRA) domestic taxpayers' receipt. The drivers affirmed that having these documents helps them avoid delays at Police checkpoints; if they possess all travel documents, it takes them less than five minutes at the Police checkpoints. However, it could take several hours at each checkpoint if they do not have the necessary travel

documents. The drivers confirmed that the longer the animals stay in transit, the more they are exposed to stress.

A livestock movement permit (Figure. 4) is needed for the transport of livestock across the borders of regions or countries, to indicate that the animals have been examined by Animal Health Officials. Prior to moving livestock under the terms of a livestock movement permit, the licensee fills out a declaration on a form issued by the Veterinary Service Department; this includes, among other things, the number of animals being transported, a description of the animals being moved, and the destination of the animals being moved. During the movement of the animals, the permittee must hold and produce for inspection a copy of the completed form at all times.

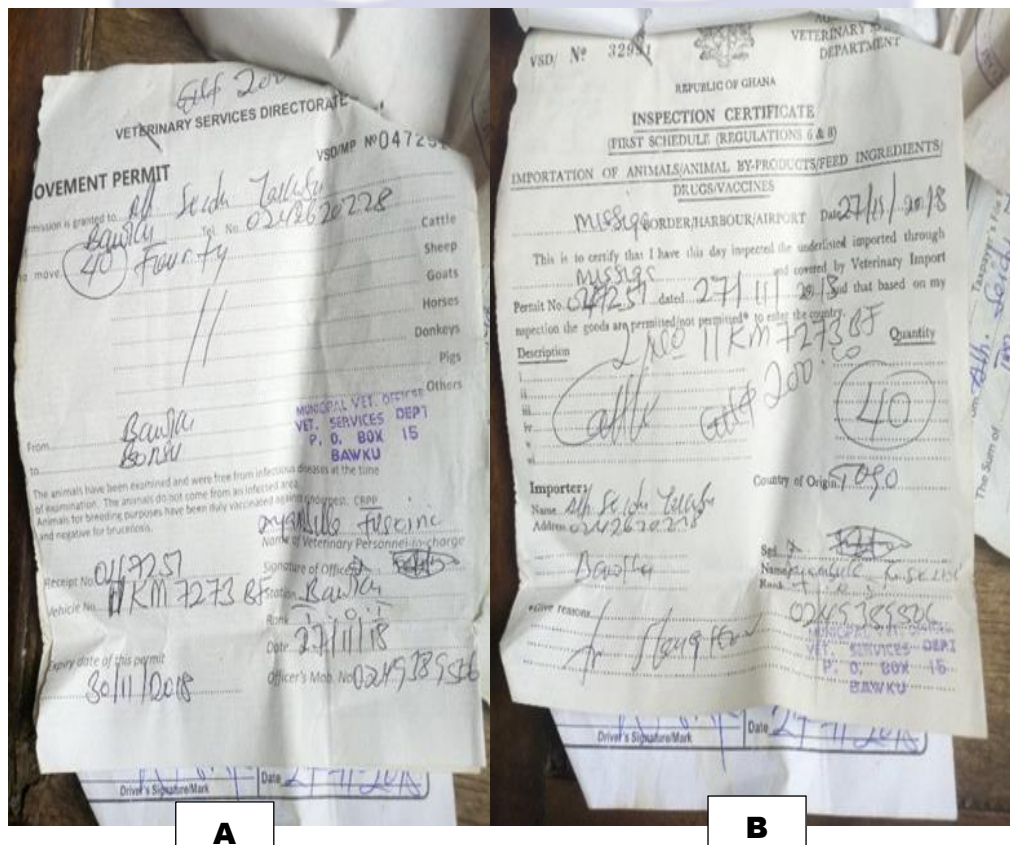


Figure 4 A and B: Samples of animal transport documents (movement permit and inspection certificate respectively)



Figure 5 A and B: Waybill and Ghana Revenue Authority tax receipt respectively

A waybill (Figure. 5) is a document that tracks the movement of livestock. During livestock transport, the waybill moves with the animals from their original pick-up point to the intended destination. It also serves as a deterrent against stock theft, and ensures accurate documentation for station management, abattoirs and export markets. When animals are transported across borders, customs duty is levied as an income levy. The GRA issues import and domestic tax payer’s receipts to drivers and merchants to provide revenue for the government, and also to facilitate trade flow of products across the national borders.

Table 6: presents the design and condition of trucks used to transport livestock

Table 6: Condition of vehicles used to transport livestock

Variables	Frequency	Percentages (%)
Roof to protect animals against rain/sun		
Yes	13	26
No	37	74
Sharp/protruding objects that can injure animals		
Yes	2	4
No	48	96
Holes, gaps, or cracks in the floor		
Yes	7	14
No	43	86
Presence of bedding materials on the floor		
Yes	50	100
No	0	0
Availability of ramps/lateral protection for loading /unloading		
No	50	100
Yes	0	0
Trucks with no side walls		
Yes	41	82
No	9	18
Partition/individual compartment		
No	50	100

Source: Field survey, Badu (2021) N= 50

It was observed that 26% of the trucks had a protective roof cover. Drivers of trucks that did not have any roof cover explained that at all times during the journey, there was a herdsman who is responsible for monitoring the animals, and these usually, sit on top of the truck; hence, it will be inconvenient to use a roof cover. Although it is important to monitor the animals while in transit, the reason given is not tenable. According to Heinz

and Srisuvan (2001), the combination of heat and direct sunlight necessitate a roof cover to protect the animals from harsh weather conditions. Moreover, the drivers' reasons for not providing roof cover is in contrast to the EC (2002) report, which states that the roof and walls of livestock vehicles should be covered to avoid heat or cold stress.



Figure 6: Livestock transport vehicle with no protective roof cover

Figure 6 shows a livestock transport vehicle that brought cattle to the Kumasi Abattoir without a protective roof cover to shield animals from harsh weather conditions.

The external walls of vehicles are significant in minimising bruises. Nonetheless, 82% of the trucks had short sidewalls to ensure this effect. The drivers explained that the side openings were purposely designed and fashioned so that regardless of the truck's condition, there would be adequate ventilation for the animals. Livestock vehicles should not be completely enclosed, as lack of airflow can lead to excessive stress or even suffocation, especially in the hot season (Heinz and Srisuvan, 2001). However, most trucks assessed in this study had short sidewalls; this exposed the animals to possible respiratory problems and cold, especially when the truck is in motion.

Findings from this study agree with the report of Broom (2008) that some trucks have well-built openable parts on the sides for vent, while others have poorly constructed ventilation options, open or bars on the sides. The latter may offer adequate ventilation but limited safety against injuries and adverse weather conditions such as rain, sunlight and strong winds.



Figure 7: Livestock transport vehicle with open sides and without roof

Figure 7 shows a livestock transportation vehicle with short sidewalls. This type of truck offers minimum protection to the animals against injuries and harsh climatic conditions when the truck is in motion, hence, such vehicles are considered unacceptable for use as livestock transport.

Nonetheless, some trucks (18%) with sidewalls present, had these made of metal instead of wood. Hardwood has been recommended as an appropriate choice for the body of transport vehicles to reduce the incidence of injuries associated with metal sheets as they become rusty and wear off (Lapworth, 2008). Regardless of this suggestion, only one vehicle was observed to have a side body made of wood. Individual partitions within a vehicle are an important component in vehicles. When available in trucks, these compartments provide animals with the ability to withstand shocks that

emanate from poor road networks and abrupt braking of vehicle (Lapworth, 2008).

Furthermore, individual partitions reduce the occurrence of fighting when trucks halt suddenly and animals bump accidentally into one another (Voslářová, Chloupek, Steinhauser, Havlíček & Večerek, 2010). However, none of the trucks (100%) in this current study was observed to have individual chambers. These findings are similar to those reported in Kenya, where livestock are usually transported in trucks with a single chamber (Wambui *et al.*, 2017). However, these were different from observations in Canada, where trucks used in transporting livestock compulsorily had individual partitions (Quandt, 2016).



Figure 8: Livestock transport truck with wooden side walls and vent, but without roof

Although all the trucks (100%) observed at the Kumasi Livestock Market had bedding materials, they were from straws, stover, groundnut husks, or sawdust. According to Hutchison, Walters, Avery, Munro and Moore (2005), livestock transport vehicles should be modified with bedding materials. However, Miranda – de la Lama *et al.* (2014) reported that

unsuitable materials (such as peanut husk or sawdust) might become slippery when it attains its optimum absorption potential. In a similar study, Southern, Rasekh, Hemphill and Thaler (2006) stated that slippery floors might cause animals to fall and get trampled upon by others, which may exacerbate injuries, and to a lesser extent, cause death.



Figure 9: Trucks with bedding materials on floor to prevent slipping of livestock

This study observed that none of the vehicles (100%) in use had loading and unloading ramps. There was no suitable ramp designed at the premises, and the trucks did not have it either, even though it is recommended to have ramps to ease such purposes, according to the guidelines provided by the FAO (Heinz & Srisuvan, 2001). In most instances, the animals were forced to move onto or out of the truck by beating them with sticks, ropes and sometimes twisting their tails, resulting in bruises. The current findings confirm those of Frimpong *et al.* (2012) which reported whipping and twisting tails of animals was prevalent at the Kumasi Abattoir. According to their report, high percentages (82.2%) of carcasses from slaughtered cattle were observed to have bruises which were attributed to mishandling. These bruises are known to have adverse economic effects because all bruises have to be

trimmed off after slaughter, or may be rejected, resulting in economic losses or reduced profit margin in some countries (Immonen, Ruusunen & Puolanne 2000).

Figure 10 shows an improvised platform that is used as loading and offloading bay at the Kumasi Abattoir



Figure 10: An improvised platform where trucks load and unload animals

A platform like this is not appropriate for such purposes. This is because in most cases, animals were seen jumping off the vehicle because the truck is quite higher than the level of the platform this could lead to injury. Again, in most cases during loading, animals were pulled onto the truck and this could possibly result in bruises.

It was observed that 74% of the vehicles were in a bad state for animal transport, and as a matter of urgency, ought to be improved; whereas less than 30% were considered to be in moderate condition. This finding contradicts Wambui *et al.* (2017), which reported that 9.33% of trucks were poorly designed and 53.33% were moderate for animal transport in Kenya. According to Steinfeld, Wassenaar and Jutzi (2006), many African countries do not have specialised trucks designed and fashioned for livestock transport. Hence, animals are transported in trucks which were not made for animal transport

and thus to a larger extent, compromise animal welfare and carcass quality (Villarroel, Maria, Sanudo, Olleta and Gebresenbet, 2003).

Table 7 presents the socio-demographic characteristics of livestock owners at the Kumasi livestock market.

Table 7: Socio-demographic characteristics of Livestock Owners/Caretakers at the Kumasi Livestock market

Variable	Frequency	Percentage (%)
Age		
≤30	9	22.5
31 – 40	9	22.5
41 – 50	10	25
51 – 60	12	30
Highest Academic Level		
JHS	10	25
SHS	4	10
No formal Education	26	65
Training on livestock handling		
Yes	18	45
No	22	55

Source: Field survey, Badu (2021)

Information gathered from this study shows a fair distribution of owners/caretakers across all the age groups: ≤ 30 (22.5%), 31-40 (22.5%), 41-50 (25%), and 51-60 (30%). However, majority (65%) of them did not have any formal education, with 25% and 10% being literate with only primary and high school level education, respectively. It was observed that most of the vendors (55%) had undergone some sort training on livestock handling at the Kumasi Livestock Market, facilitated by animal welfare and non-governmental organisations; therefore, it is expected that animal welfare conditions would be improved at the Kumasi Livestock Market.

Welfare of animals at the Kumasi Livestock Market

All the respondents were holding their animals either in an open space or in kraals with no shelter to protect them from harsh weather conditions (rain and sun rays) at the Kumasi livestock market (Figure. 11). Keeping animals in an open space with no protection against rain and sun could be detrimental to the health of livestock. The animals may suffer heat stress which leads to dehydration and in effect results in loss in weight, and could even result in the death of animals if it persists for a long time. Moreover, in situations where the environmental temperature is very low or windy, the animals may suffer hypothermia which could possibly lead to pneumonia or respiratory disorder. Such adverse conditions compromise the health and welfare of animals, and to a greater extent affect the meat quality (Gebresenbet *et al.*, 2011). Figure 11 shows animals that are kept in open space. According to the livestock merchants, keeping animals in the open space is a big challenge for them because, both humans and livestock suffer the effects of heat stress from the sun and also, the floor becomes muddy whenever rain falls. This prevents potential buyers from coming there to buy animals which results in possible economic loss.



Figure 11: Animals in open space without shelter, nor free access to water at the Kumasi livestock market

Feeding animals at Kumasi Livestock market

On the issue of feeding animals at the Kumasi livestock market most of the owners/caretakers fed their animals while at the market. However, the feeding is done once a day, while other caretakers sent their livestock to distant locations for grazing. (Figure. 12). Although the animals are fed while at the market; it was observed that the animals were offered feed (forage) on the floor, without use of any feed containers. Feeding animals on the bare floor could be a possible source of microbial contamination. According to Ellis (1969), bacterial contamination of livestock feed is a possible major route by which microbes enter the human food supply chain. These pathogens may contaminate livestock carcasses at the slaughter plant, which could cause illness in humans. In situations where animals walk to search for feed elsewhere outside the market, this is a problem because there is the uncertainty of finding feed, particularly during dry seasons; however, if they find feed, animals spend energy to walk back to the livestock market, which means that

they are less likely to meet their nutritional requirements. In both situations, the welfare of animals is compromised at the Kumasi livestock market.



Figure 12 A and B: Fresh forage fed to animals at the market, and others are sent to distant locations for grazing respectively

Water provision for animals at the Kumasi livestock market

Water deprivation was not a problem at the Kumasi livestock market, as all the respondents answered affirmatively to providing water ad-libitum for the animals. The issue, however, has to do with the source from which the animals drink. A distance of 20 meters away from the livestock market is pipe-borne water which flows into a dilapidated receptacle that hosts many algae. Next to this is a deserted fish pond filled with water. These two points are the primary sources of drinking water for the animals, especially when they are offloaded from a truck or return from grazing fields; while some owners/caretakers fetched water into basins for their animals. (Fig. 13).



Figure 13: Receptacle for drinking water for animals at the Kumasi livestock market

From this study, the receptacles for drinking water were untended at the Kumasi livestock market, which resulted in them being dirty and filled with algae. This medium could be a possible source of water contamination, and as the animals' drink from it could result in waterborne infections, increasing the risk also of waterborne transmission to humans. According to Church (1991), it is largely regarded as important to supply clean, fresh drinking water for optimum health and increased production (eggs, milk, meat). Agreeably, drinking water for animals enormously infested with enteric pathogens could potentially result in livestock infection within a short time (LeJeune *et al.*, 2001).

From this study, 13% of the respondents experienced mortality while the animals stayed at the market. However, the deaths are recorded occasionally. Again, those who recorded the incidence of mortality were asked if they did post mortem examination. Respondents recounted that any time there was mortality; they would call on the veterinary officers at the Kumasi

abattoir to examine their dead animal. Most often, the outcome was not pathogen-related but a result of heat stress. Carcasses from such dead animals were sent to the Kumasi zoo to feed carnivorous animals there, while those not fit for consumption were buried. On how long animals stayed at the market from the time they were brought in, they all indicated that it depended on the market, they could sell their animals within 7 days, but on festive occasions (e.g. Christmas, Easter, Eid al-Fitr), it could be less than four days.

Concerning possible ways in which their work could be improved, most of the respondents suggested that NGOs should come to their aid and build structures or facilities that could house the animals properly; financial assistance from the government by giving them loans at low-interest rates to boost their business; and reducing the excessive import duty charges on animals.

Stunning operations in selected locations

From this study information gathered was that the Tamale Abattoir was not using the stunners previously donated to them by the Animal Welfare Organization (Eyes on Animals). This is because it was a Muslim-dominated community, that adheres to the principles of *Halal* slaughter that propose that animals must be slaughtered while alive; therefore some stunning methods which are mostly irreversible, are not allowed. All the butchers, asserted to have received livestock slaughter training and how to use humane slaughter equipment. Respondents recounted that the training focused on handling and operating a humane slaughter device including targeting the best-fit position to achieve a successful stun, and the overhaul and service of such a device. Stunning before slaughter is a legislative prerequisite in the EU to render an

animal unconscious and insensate (unable to respond to stimuli). Hence the slaughter is carried out without distress, pain, fright, suffering and anxiety on the part of the animal (Petracci, Bianchi & Cavani, 2010). In all the selected abattoirs and slaughterhouses except Tamale Abattoir, respondents agreed to stun animals before slaughter.

However, butchers at the cattle section of the Kumasi Abattoir do not stun animals before slaughter. Their reason is that they adhere to the *halal* slaughter to satisfy Muslim consumers who patronize meat from the Kumasi abattoir. The application of regulation (EC No. 1099/2009) regarding the welfare of animals at the point of slaughter became pertinent from January 2013. Globally, this statutory requirement is to ensure livestock are unconscious (stunned) before slaughter. Nevertheless, it permits slaughter without stunning for specific practices promulgated by a religious order. This view is applicable under Jewish and Muslim rites (*Kosher* meat and *halal* meat), respectively (Bradley, Nganga, Marechal and Garrone, 2015). In practice, to supply a greater share or percentage of the local market, management of the Kumasi Abattoir employs this slaughter method (*halal*) to serve its Muslim customers who may demand *halal* meat at all cost.

It was found that captive bolt stunners donated to the Kumasi Abattoir were part of the humane slaughter device donated to selected slaughterhouses (Figure 14). The captive bolt stunner is an all-around stunning device which is ideal for use on all livestock species (Heinz & Srisuvan, 2001). It has an extendable rod that penetrates the brain and causes significant physical brain damage. Most US cattle plants that perform modern slaughter employ penetrating captive bolts. Penetrative captive bolts, when properly employed,

can trigger immediate unconsciousness since the ability to respond to stimuli is raptured in the brain (Daly *et al.*, 1988).

Benefits associated with the use of Captive Bolt Stunners at selected slaughterhouses

When respondents were asked of the benefits, they had noticed that with the use of the device, three themes were dominant and the stunner had come to help make slaughtering faster and easier: for instance, previously, cattle had to be restrained with ropes and held tight to the floor before slitting the neck. Now, with the stunners in possession it had helped to avoid this act of cruel handling before exsanguination. Again, they said less labour was required to slaughter an animal, unlike previously when about five people would be required to restrain an animal before exsanguination. It had also helped reduce the risk of slaughter injuries, especially if the animals become aggressive.



Figure 14: Captive bolt stunners (A, B, & C) donated to the UCC slaughterhouse, Cape Coast slaughterhouse, and Kumasi Abattoir respectively

Challenges associated with the use of captive bolt stunners at selected slaughterhouses

On the whole, it was observed to be very productive stunning equipment, if used correctly; nevertheless, it came with some shortfalls. Respondents recounted that the device became hot when used for a continuous period of time. This reduces the efficiency of operations, especially when a lot of animals are to be slaughtered at the same time as it resulted in less output per hour. These findings agree with Gregory (2008) who reported that captive bolt stunners get heated up at high firing rates and the metallic surface becomes very hot when the temperature exceeds 50° C; consequently, the device becomes difficult to handle for more than 10 seconds. Therefore, it becomes necessary to give it time to cool down; so, an extra gun is required in such cases. Alternatively, heavy leather gloves are required to be worn by the operator.

Secondly, respondents argued that opening and replacing cartridges after every shot was also a problem to them, especially when one misses the target during a stun. Reloading could take a long period of time, thus defeating the aim of stunning prior to slaughter. Therefore, it is recommended to have a spare gun as a backup to be used immediately, when there is a miss fire with a first shot.

Thirdly, the lack of cartridges and spare parts to replace broken down or faulty parts of stunners is also a challenge they face.

On the current condition and use it was found out that both the University of Cape Coast (UCC) and Cape Coast Metro slaughterhouses had their captive bolt stunners still in use, although they were in poor condition



Metro slaughter slab where the performance efficiency of the stunners were reducing with age. According to Grandin (1998a), four primary reasons account for captive bolt failure to render livestock unconscious with a single shot: (i) zero maintenance, (ii) wet cartridges in cartridge-fire captive bolt, (iii) low air pressure in pneumatic captive bolt guns (iv) aggressive animals that makes it difficult to properly position the stunner. A study conducted in ten abattoirs found that zero regular maintenance was the highest cause of captive bolt misfiring (Grandin, 1998b). For a high score, the author urged that stunners ought to be kept clean and serviced daily after use, adhering to manufacturers' guidelines to avoid misfiring. According to Gregory and Grandin (2007), it is recommended to position the stunner in the correct place on the forehead for effective firing. Again, Ewbank, Parker and Mason (1992) stated that a head restraint is needed for a precise and accurate shot, although it may worsen stress if it is wrongly used. To reduce stress, stunning ought to be done in less than 6 seconds after restraining the head (Grandin & Smith 2004).

Butchers from the various slaughter plants suggested that spare parts for captive bolt stunners should be made readily available to them. When these spare parts are available, it could help improve the maintenance of the device. More particularly, butchers from the Cape Coast Metro slaughterhouse made a plea for provision of a mechanical head restraint which could help in easy targeting of the correct position on the forehead of animals. They expressed gratitude to their donors (Eyes on Animal), personnel of the West African Centre for the Protection of Animal Welfare (WACPAW), and the Department of Animal Science, University of Cape Coast, for their support and regular visits to their premises for advice and guidance.

Meat Consumers

Table 8 presents the socio-demographic characteristics of the meat consumers in the study.

Table 8: Socio-demographic characteristics of meat consumer selected for the study

Variable	Frequency	Percentage (%)
Gender		
Male	26	15.3
Female	144	84.7
Total	170	100
Age grouping (years)		
20 – 30	34	20
31 – 40	67	39.4
41 – 50	44	25.9
51 – 60	23	13.5
Over 60	2	1.2
Total	170	100
Marital status		
Married	147	87
Single	22	13
Total	169	100
Educational background		
GCE/O – Level	62	37
A – Level	39	23.2
Graduate	12	7.1
No formal education	55	32.7
Total	168	100
Employment status (public, private and self-employed)		
Employed	136	82.4
Unemployed	29	17.6
Total	165	100
Religious affiliation		
Christianity	105	62
Muslim	63	37
Traditional religion	1	1
Total	169	100

Source: Field survey, Badu (2020)

Table 8 presents the socio-demographic characteristics of the respondents. About 85% of the respondents were female, with the rest being male. Females dominated this study because in most Ghanaian homes' food purchasing decisions are taken by women (Anil, 2012; Teye, Fuseini and Odoi, 2020), and so in most of the households visited, the researchers were directed to the women to fill out the questionnaires. The few male respondents in the study were either unmarried or divorced, and so managed their own domestic lives. On the respondents' age, it was observed that it was fairly distributed from 20 to 60 years old. This is a good representation, as the findings can be generalised for almost all age groups. In terms of religious beliefs, majority (62%) of the respondents were Christians, while 37% were Muslims. This observation might be a reflection of the relatively larger non-Muslim population (84%) in Kumasi, compared with Muslim (16%) population (MCI, 2008). Earlier studies indicate that religion and belief systems directly affect product patronage in that, the mode of production, handling, or marketing can impact consumers' understanding and preference for a given product (Claret *et al.*, 2014). About 82.40% of the consumers were employed (public sector, private sector and self-employed), indicating that they could make personal purchases of meat. According to Guerrero *et al.* (2012), consumers' social standing or economic well-being determines the frequency and quantity of meat they purchase.

Table 9 indicates consumers’ knowledge of the stunning of animals before slaughter.

Table 9: Consumers’ knowledge on stunning of animals prior to slaughter

Variable	Frequency	Percentage (%)
Awareness on stunning of livestock prior to slaughter		
Yes	9	5.6
No	151	94.4
Total	160	100
Consumers’ conviction that stunning reduces pain to the animal being slaughtered		
Yes	49	32.7
No	101	67.3
Total	150	100
Existence of religious rules on livestock slaughter among respondents		
Yes	61	37.2
No	103	62.8
Total	164	100
Consumers’ meat purchasing points		
Any available butchers’ shop	72	43
Muslim butchers’ shops only	49	29
Cold-stores	46	28
Total	167	100
Preferred method of livestock slaughter		
Pre-stunned slaughter on condition that the animal was alive at the point of bleeding out	2	1.2
Slaughter without stunning	60	35.3
Indifferent	108	63.5
Total	170	100

Source: Field survey, Badu (2020)

Respondents were asked if they knew what stunning of livestock before slaughter meant. The results indicated that 94.4% had no knowledge of what stunning of livestock entailed. It is not surprising because many traditional abattoirs in Ghana did not have functional stunners until 2018, when a Dutch-based organisation, Eyes on Animals (EonA), donated stunners to selected abattoirs in Ghana. Prior to that, animals were mainly slaughtered without any form of stunning in commercial abattoirs which indicates that most of the consumers may not know whether animals are stunned prior to slaughter or not.

According to Velarde *et al.* (2014), stunning before bleeding is a legal requirement within the European Union (EU) and is applied to render animals insensitive to the pain associated with neck cutting during slaughter. It is worth noting that the EU regulation on the protection of animals at the time of killing (EC1099/2009) permits member states to apply a derogation allowing slaughter without stunning for religious rites (e.g., *Halal* and *Shechita* slaughters). A study commissioned by the European Commission on information to consumers regarding stunning of animals prior to slaughter concluded that EU consumers did not understand the different stunning/slaughter methods (Bradley *et al.*, 2015). This is consistent with the findings from the current study that majority of meat consumers did not know what stunning entails. About 32.70% agreed that stunning is capable of reducing the pain of slaughter, but the majority (67.30%) indicated that they did not agree. Fuseini *et al* (2017b) made a similar observation in a study involving UK *Halal* meat consumers. The 67.30% of respondents from this study who were not convinced on the humaneness of stunning explained that,

shooting inflicts pain on the animal and therefore, it cannot be a humane practice. Others argued that the stunning process is an act of torture because the force exerted by the bolt inflicts pain before the animal falls unconscious. However, it was explained to them that the force exerted impacts the brain and causes immediate loss of sensibility. In a review of different slaughter methods and their impact on carcass and meat quality, Anil (2012) suggested that some stakeholders associate stunning with inflicting pain to animals, and that some Muslims have suggested that blood loss is negatively impacted when animals are stunned prior to slaughter.

The respondents were then asked whether they were aware of any religious rules regarding stunning of animals. Majority (62.8%) stated 'No' to indicate that they were unaware of any religious rules governing stunning prior to slaughter. These people were mainly adherents of the Christian faith, while those who said 'Yes, were followers of the Islamic faith. According to the teachings of Islam, meat is classified as "*Halal*", when animals at the point of bleeding are alive. One of the objectives of the animal being alive is to ensure adequate bleeding-out at slaughter, to improve meat quality, and minimise rates of microbial spoilage in storage.

Respondents were then asked to indicate their main points of purchase of meat; 43% indicated that they purchased their meat from independent butchers, and their main reason was for convenience. A further 29% indicated that they purchased their meat and meat products from independent Muslim butchers. These categories of consumers were mainly of the Islamic faith, so they believed that such butchers can vouch for the *halal* status of the meat. This is consistent with findings of Bonne *et al.* (2008), that Muslim consumers

were more confident in purchasing *halal* meat from Muslim-operated butcher premises. However, 28% of respondents indicated that they buy meat mainly from cold-store operators; their reason was that such premises are more hygienic and products are perceived to be safer than those from independent butcher shops. In Ghana, meat is mainly sold by butchers who operate in open spaces with no refrigeration facilities, and these butchers usually sell meat from locally processed animals. On the other hand, some retailers sell meat in refrigerated units, popularly known as cold stores. Meats sold in cold stores are usually those imported from Western countries with unknown *halal* status.

About 35% of the respondent preferred that livestock are slaughtered without stunning while 1% preferred pre-stunned slaughter on condition that the animal was alive at the point of bleeding out. However, the majority 63% were indifferent on the preferred method of livestock slaughter. This means one might not be bothered so much on how an animal was slaughtered provided the meat is wholesome for human consumption. Moreover, findings from this study indicate that most consumers are interested in the final product, irrespective of how the slaughter was performed.

The factors influencing consumers' decisions to purchase meat of stunned animals are presented in Table 10.

Table 10: Factors influencing the willingness of consumers to patronise meat of stunned animals

Variable	Probit Regression	
	Coefficient	Marginal effect
Age	-1.9303** (0.7628)	-0.0839
Gender	0.9607* (0.5250)	0.0431
Marital status	-0.8784 (0.9634)	-0.0352
Religion	-5.1575*** (1.4639)	-0.5127
Source of meat	-0.0254 (0.9391)	-0.0011
Knowledge on stunning	1.6649** (0.6710)	0.0791
Check product label for safety	-0.6323 (0.8954)	-0.0249
Preferred meat	0.9490* (0.5764)	0.0383
Stunning reduces pain	2.5572*** (0.6850)	0.1575
Devoted Muslim	-1.9193*** (0.6115)	-0.1273
Constant	9.1803** (3.6696)	
Prob > chi ²	0.0000	
Pseudo R ²	0.8777	
Log-likelihood Probit	-10.5924	
Wald Chi2 (10)	84.01	

*, **, *** significant at 10, 5 or 1%, respectively. Figures in parenthesis are the robust standard errors

The coefficient of age is negative and significantly different from zero (p<0.05), suggesting that age is less likely to influence the purchase of meat of stunned animals amongst 8.39% of the consumers. This finding contradicts

those of Ibrahim (2011) and Yakaka, Iheanacho and Babagana (2012), who observed a positive relationship between age and the purchase of meat of stunned animals.

Conversely, gender had a positive influence on the decision to purchase meat of stunned animals; this was higher for female consumers, indicating that females have a higher propensity to purchase such meat, than males. This is consistent with the findings of Uzuno and Karakas (2014), who reported a positive association between gender and the decision to purchase meat. This positive association might be due to women's role as food purchasing decision-makers in most Ghanaian homes (Teye *et al.*, 2020).

There was a negative influence of religion on the decision to purchase meat of stunned animals. In general, Muslim consumers (about 51.27%) are less likely to purchase meat of stunned animals, compared with non-Muslims. The negative association between religion and the purchase of meat of stunned animals is at variance with the study conducted by McLean-Meynsse *et al.* (1996) when they reported a positive relationship between religion and the purchased of meat of stunned animals. Perhaps, the reason for this association is that the consumers who are non-Muslims have high curiosity to taste the meat of stunned animals, vis a vis Muslims who are subjected to the tenets of purchasing such meats on religious grounds.

The result from this study further indicates that knowledge on stunning had a positive significant coefficient at ($p \leq 0.50$). An implication for this relationship is that consumers who knew of stunning are more enlightened about the importance of consuming meat of stunned animals; thus, they are more encouraged to purchase such meats, relative to those who did not know

much about stunning. Notably, consumers who knew about stunning were 7.91% more likely to purchase meat of stunned animals, compared to those with no knowledge on stunning. The preference for meat from stunned animal is more likely to increase from the low recorded level of 3.83% of consumers. This result is consistent with Garnier, Klont and Plastow (2003), who revealed that preference directly influenced purchase of meat and meat products. Consumers who believe stunning reduces pain were more likely to purchase meat of stunned animals (15.75%), compared to the rest. Perhaps, consumers who believed that stunning could reduce the pain of animals, had more concern for the welfare of animals; as a consequence, the resultant positive effect. This result is similar to findings of Aghwan, Bello, Abubakar, Imlan and Sazili (2016), who reported that the ability of a stun to reduce pain and suffering among livestock, positively induces consumers to purchase meat of stunned animals. In contrast, devoted Muslims are less likely purchase meat of stunned animals (by 12.73%), compared to non-devoted ones. This finding is at odds with earlier research by Bonne and Verbeke (2008) because devoted Muslims adhere to the dogma of Sunnah or Q'uran, for which reason they are more likely to perceive meat from stunned animals as *haram*.

Islamic Scholars

The response of some Islamic scholars on stunning of animals prior to slaughter is indicated in Table 11.

Table 11: Islamic Scholars’ knowledge on stunning prior to slaughter

Variable	Frequency	Percentage(%)
Knowledge on stunning of livestock before slaughter		
Yes	12	68.4
No	6	31.6
Opinion of the Islamic religion on stunning		
Allowed	10	66.7
Not allowed	5	33.3
Knowledge on pre-stunning and post-cut stunning in <i>halal</i> slaughter		
Yes	11	57.9
No	8	42.1
Information expected on packs of meat from stunned animals		
The method of stunning	1	5.3
An indication of the reversibility of the stunning system	4	21.1
Logo of the <i>halal</i> certification body	11	57.9

Source: Field survey, Badu (2020)

Stunning is a relatively new slaughter technique; thus, the Islamic scriptures are silent on it. According to Fuseini, Knowles, Hadley, Wotton and (2016a), the acceptability or prohibition of stunning is therefore open to interpretation by Islamic scholars. Nonetheless, Abdullah, Borilova and Steinhauserova (2019) explained that issues related to stunning have to do with fulfilling the conditions and guiding beliefs mentioned in the fundamental sources of Islamic jurisprudence. From Table 11, some of the respondents (31.6%) did not know what stunning meant. This suggests that although the Scholars are well educated in Islamic literature, they are not well vexed in the

science of slaughter. Therefore, their willingness to accept or reject stunning may be influenced by individual discretion and hearsay, but not necessarily based on Islamic principles. An education of these people on the science of livestock slaughter is therefore very paramount to enable them make informed decisions.

Stunning is a fairly new concept in Ghana, coupled with the fact that it is not part of the Islamic customs and traditions concerning the slaughter of animals. Upon explanation of the principles behind stunning, 66.7% of the scholars agreed that it might be permissible in Islam on condition that the animal must be alive at the point of exsanguination. On the contrary, 33.3% of the respondents believed that stunning is irreversible; that is, it is meant to kill the animal, and is therefore unlawful. Such an assertion confirms the findings of Chandia and Soon (2018) that if stunning before slaughter does not keep the animal alive before bleeding-out, it may not be acceptable to many *halal* meat consumers. It was found that a majority (57.9%) of the Islamic scholars in this study knew what pre-stunning and post-cut stunning entails. The validity of pre- and post-slaughter stunning of livestock is still a subject of contention among these jurists (Fuseini *et al.*, 2016b). According to a 2014 inquiry by the All-Party Parliamentary Group (APPG) in the United Kingdom investigating *halal* slaughter of lamb and cattle, the association would permit post-cut stunning for *halal* slaughter to lessen the length of pain following the *halal* cut. In contrast to the slaughter of livestock without any sort of stunning, post-neck-cut stunning improves animal wellbeing (Gregory *et al.*, 2012). However, one of the key obstacles of post-neck-cut stunning is keeping the animal in position so that the stunning apparatus may be precisely deployed. It is

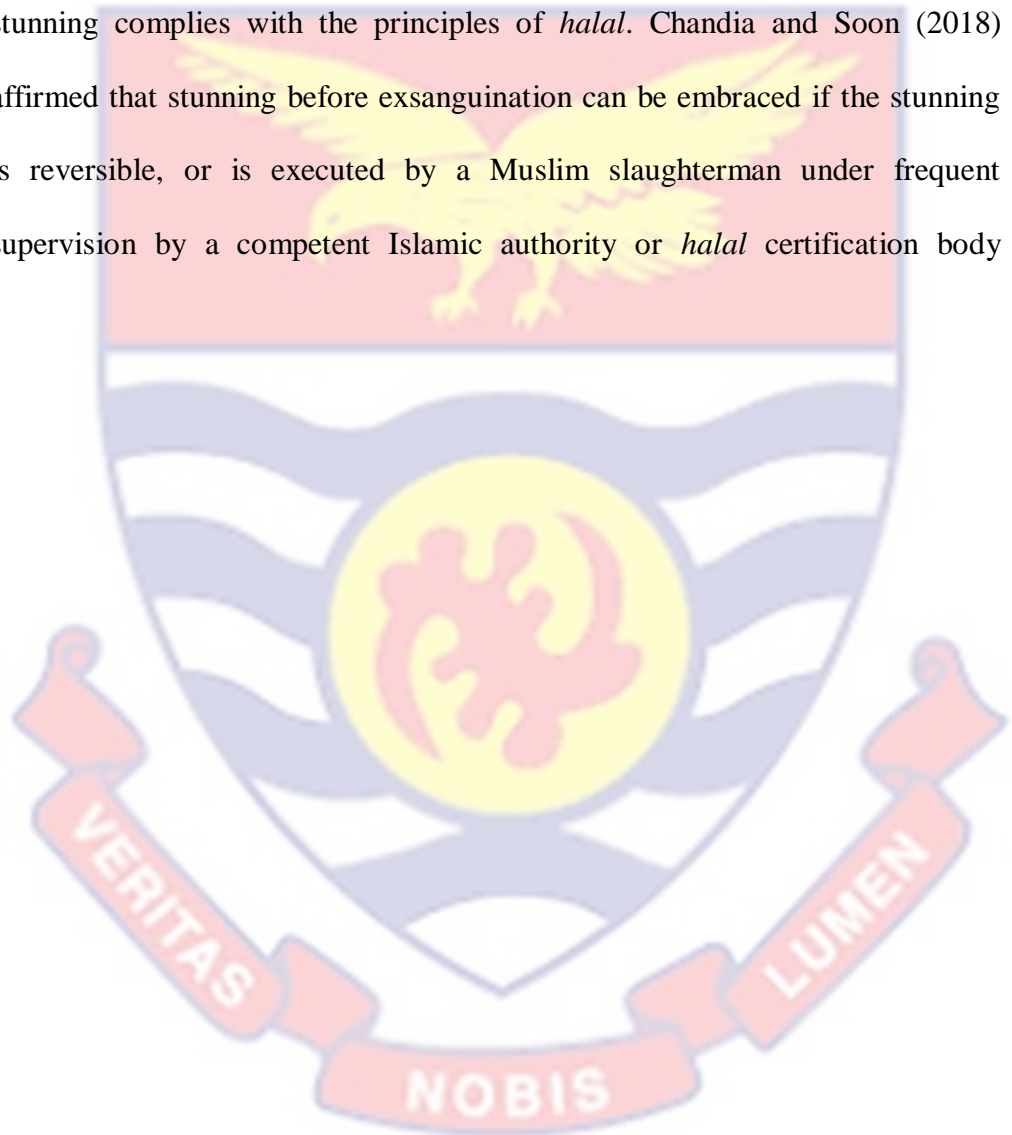
important to point out that some stunning methods are reversible (e.g., electrical head-only stunning); that is, they do not result in the death of animals. Islamic scholars need to be aware of these methods if their opinion on stunning is to be relevant. The major challenge of Islamic scholars in accepting pre-slaughter stunning of animals in Ghana is that the penetrative captive bolt is the commonest stunner found, and this has possibility of causing death of animals if the period between stunning and bleeding prolongs; hence, it will not be readily acceptable to a majority of Muslims (Fuseini *et al.*, 2016b). Moreover, the delay in bleeding could result in blood spots in the muscle of the carcass, which could be selected against by consumers. Processors on the other hand, would have to trim off these blood spots which will result in reduced carcass yield and consequently, lead to reduced profit margins.

There are varying views of Muslims regarding stunning acceptability prior to slaughter, as reported in the current study. A School of Thought may influence the acceptability of stunning. For example, stunning is acceptable to most scholars in Malaysia (which follows the Shāfī School of Thought). On the contrary, it is not accepted in Pakistan (which follows the Ḥanafī way of thinking) (Lever & Miele, 2012). According to Anil and Gregory (2014), the current disposition of Muslims on preslaughter stunning can be partitioned into three principal beliefs or expression of views: acceptance with explicit necessities (reversible stunning); dismissal because of the inconsistency with religious standards, and inadequate bleeding (as blood is prohibited); and not specific yet, or requiring absolute affirmations.

While there is currently no recognised *halal* certification body in Ghana, most respondents (57.9%) in the current study indicated that they would expect to see the logo of the *halal* certification body on the packaging material before purchasing meat and meat products. Islamic dietary laws categorise food into permissible (*halal*) and forbidden (*haram*). These dietary laws are derived from the Quran and Hadith, and are interpreted by Islamic jurists (Riaz & Chaudry, 2003). Islamic dietary laws are binding on Muslims, and should be observed consistently (Bonne & Verbeke, 2008). The significance of religion on meat consumption and animal welfare have been well accounted for. For example, Muslims and Jews are prohibited from eating meat from specific animals (e.g., the pig), and they are expected to follow particular rules during the slaughter of 'acceptable' types of animals for food.

In the present study, 21.1% of the respondents indicated that they would expect an indication of the reversibility of the stunning system on meat packs. In countries such as Australia, the National Standards demand livestock stunning before slaughter, for welfare reasons. Nevertheless, *halal* slaughter using reversible stunning methods such as electric shock and Carbon dioxide is permitted by Fellow of the Royal Society of Chemistry (FRSC). Farouk *et al.* (2016) reported that reversible pre-slaughter stunning technology is persistently developing in the meat industry to enhance animal welfare during slaughter and also meet the pre-requisites for *halal* slaughter. The authors affirmed that modern methods could be applied in the *halal* meat industry, where they will satisfy both *halal* slaughter and the legislation standards. For this study, the reason for some Islamic scholars selecting the reversibility of the stunning systems on a product against other responses was that the

reversibility of the stunning is proof that the animal will regain consciousness if it is not bled after a while. The use of captive bolt stunners however, may not be reversible, as some animals may die if bleeding is delayed after stunning. This finding agrees with that of Fuseini *et al.* (2017a), who reported that the majority of Islamic scholars and consumers indicated that reversible stunning complies with the principles of *halal*. Chandia and Soon (2018) affirmed that stunning before exsanguination can be embraced if the stunning is reversible, or is executed by a Muslim slaughterman under frequent supervision by a competent Islamic authority or *halal* certification body



CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

It was observed that over 52% of the animals transported to the Kumasi Livestock Market were sourced from within Ghana, whereas the remaining 48% originated from neighbouring countries such as Burkina Faso (30%), Mali (12%) and Togo (6%). Up to, 74% of the vehicles used to transport animals were generally in bad condition and needed immediate improvement. Quality features to be included were adequate ventilation, modified floors with bedding materials (non-slip floors), and elimination of protruding objects or cracks etc.

Mortalities recorded in this study were 2.5% and 1.3% for animals sourced from neighbouring countries and those from Ghana respectively, indicating that drivers were not fulfilling some requirements to ensure good animal welfare.

It was observed that conditions at the Kumasi Livestock Market were generally poor; animals were kept in open places and in kraals with no shelter; feed was offered on the bare floor with no feed troughs and dilapidated receptacles for drinking water, which are all indicators that animal welfare is compromised.

The captive bolt stunners donated to them by the Eyes on Animals group were either broken down or in poor condition and needed spare parts to service them regularly.

Butchers at the selected slaughterhouses agreed to stun their animals, but those at the cattle plant at the Kumasi and Tamale Abattoirs refused to use the stunners on religious grounds.

Majority of the Islamic Scholars interviewed agreed that stunning is allowed, provided the animal is not dead at the point of bleeding out.

This study observed that the majority of meat consumers do not know what stunning is. However, the few who knew what stunning was, indicated that it could reduce pain associated with neck cutting.

It was also observed that Ghanaian consumers are interested in the final product, irrespective of how the slaughter was performed, thus stunning or otherwise, may not affect the meat purchasing intentions of most Ghanaians. Generally, the gender of the consumer and knowledge of stunning and beef as preferred meat positively influenced the willingness to purchase meat of stunned animals.

Recommendations

Further studies should be conducted to assess the effect of transport on carcass quality and its economic losses on animals transported to selected slaughterhouses.

Since many consumers are interested in the final product, it can be recommended that slaughterhouses in Ghana be equipped with different types of stunners so that the most appropriate ones for the species could be used for improved welfare of slaughter animals, and at the same time, satisfy religious concerns.

Given the importance of the *halal* meat market segment, future research is recommended to spotlight the attitudes of Muslims towards *halal*

meat, their actions in finding knowledge, and their perceived need for and trust in labelling initiatives.

It is recommended that Muslim consumers and butchers are educated on stunning and its role in reducing pain associated with slaughter, so they can better appreciate it. This might go a long way to improve the animals' welfare at slaughter, hence meeting some international slaughter requirements.



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APPENDICES

APPENDIX A: SOCIAL-DEMOGRAPHIC CHARACTERISTICS OF MEAT CONSUMERS

Frequency Table

Gender of respondent				Valid	Cumulative
		Frequency	Percent	Percent	Percent
Valid	Male	26	15.3	15.3	15.3
	Female	144	84.7	84.7	100.0
	Total	170	100.0	100.0	

Age of respondent				Valid	Cumulative
		Frequency	Percent	Percent	Percent
Valid	20-30	34	20.0	20.0	20.0
	31-40	67	39.4	39.4	59.4
	41-50	44	25.9	25.9	85.3
	51-60	23	13.5	13.5	98.8
	over 60	2	1.2	1.2	100.0
	Total	170	100.0	100.0	

Respondent marital status				Valid	Cumulative
		Frequency	Percent	Percent	Percent
Valid	Single	22	12.9	13.0	13.0
	Married	147	86.5	87.0	100.0
	Total	169	99.4	100.0	
Missing	System	1	.6		
Total		170	100.0		

Highest academic level		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	GCSE/O-Level	62	36.5	36.9	36.9
	A-Level	39	22.9	23.2	60.1
	Graduate	12	7.1	7.1	67.3
	No formal education	55	32.4	32.7	100.0
	Total	168	98.8	100.0	
Missing	System	2	1.2		
Total		170	100.0		

Religion of respondent		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Christian	105	61.8	62.1	62.1
	Moslem	63	37.1	37.3	99.4
	Other	1	.6	.6	100.0
	Total	169	99.4	100.0	
Missing	System	1	.6		
Total		170	100.0		

Employment status		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	136	80.0	82.4	82.4
	No	29	17.1	17.6	100.0
	Total	165	97.1	100.0	
Missing	System	5	2.9		
Total		170	100.0		

APPENDIX B: CONSUMERS' CONVICTION ON STUNNING OF ANIMALS TO SLAUGHTER

Respondent knowledge on stunning of livestock prior to slaughter

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	9	5.3	5.6	5.6
	No	151	88.8	94.4	100.0
	Total	160	94.1	100.0	
Missing	System	10	5.9		
Total		170	100.0		

Consumers' conviction that stunning reduces pain to the slaughter animal

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	101	59.4	67.3	67.3
	No	49	28.8	32.7	100.0
	Total	150	88.2	100.0	
Missing	System	20	11.8		
Total		170	100.0		

Consumers' meat purchasing point

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Any butcher in the market	43	25.3	25.7	25.7
	Muslim butchers in the market	49	28.8	29.3	55.1
	Coldstore operators	46	27.1	27.5	82.6
	Anywhere at all I find meat	29	17.1	17.4	100.0
	Total	167	98.2	100.0	
Missing	System	3	1.8		
Total		170	100.0		

Preferred method of livestock slaughter				Valid	Cumulative
		Frequency	Percent	Percent	Percent
Valid	Pre-stunned slaughter on condition that the animal was alive at the point its neck was cut	2	1.2	1.2	1.2
	Slaughter without stunning	60	35.3	35.3	36.5
	Indifferent	108	63.5	63.5	100.0
	Total	170	100.0	100.0	

APPENDIX C: ISLAMIC SCHOLARS' KNOWLEDGE ON STUNNING PRIOR TO SLAUGHTER
FREQUENCY TABLE

Knowledge on stunning of livestock before slaughter				Valid	Cumulative
		Frequency	Percent	Percent	Percent
Valid	Yes	12	63.2	66.7	66.7
	No	6	31.6	33.3	100.0
	Total	18	94.7	100.0	
Missing	System	1	5.3		
	Total	19	100.0		

Opinion of the Islamic religion on stunning of livestock prior to slaughter				Valid	Cumulative
		Frequency	Percent	Percent	Percent
Valid	Allowed	10	52.6	66.7	66.7
	Not Allowed	5	26.3	33.3	100.0
	Total	15	78.9	100.0	
Missing	System	4	21.1		
	Total	19	100.0		

Information expected on packs of meat from stunned animals

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	The method of stunning	1	5.3	5.3	5.3
	An indication of the reversibility of the stunning system	4	21.1	21.1	26.3
	The logo of the Halal certification body which approved the product (if the meat is certified)	11	57.9	57.9	84.2
	Not applicable I do not never buy meat of stunned animal	3	15.8	15.8	100.0
	Total	19	100.0	100.0	

APPENDIX D: SOCIAL-DEMOGRAPHIC CHARACTERISTICS OF LIVESTOCK TRUCK DRIVERS

Age group of livestock truck drivers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 30	1	2.0	2.0	2.0
	31-40	18	36.0	36.0	38.0
	41-50	26	52.0	52.0	90.0
	51-60	5	10.0	10.0	100.0
	Total	50	100.0	100.0	

Highest Academic qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	JHS	17	34.0	34.0	34.0
	SHS	15	30.0	30.0	64.0
	Graduate	1	2.0	2.0	66.0
	No formal education	17	34.0	34.0	100.0
	Total	50	100.0	100.0	

APPENDIX E: ORIGIN OF LIVESTOCK AND CONDITIONS UNDER WHICH THEY ARE TRANSPORTED TO KUMASI ABATTOIR/LIVESTOCK MARKET.

Origin of animals

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Burkina Faso	15	30.0	30.0	30.0
	Mali	6	12.0	12.0	42.0
	Togo	3	6.0	6.0	48.0
	Ashanti Region	6	12.0	12.0	60.0
	Northern Region	12	24.0	24.0	84.0
	Tamale				
	Upper East (Bawku, Paga)	6	12.0	12.0	96.0
	Upper West (Wa)	2	4.0	4.0	100.0
	Total	50	100.0	100.0	

Training on livestock handling

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	16.0	16.0	16.0
	No	42	84.0	84.0	100.0
	Total	50	100.0	100.0	

Species of animals transported					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Cattle	35	70.0	70.0	70.0
	Cattle, Sheep, Goat, Pig	15	30.0	30.0	100.0
	Total	50	100.0	100.0	

Do you stop at a staggng point					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	23	46.0	46.0	46.0
	No	27	54.0	54.0	100.0
	Total	50	100.0	100.0	

APPENDIX E: CONDITIONS OF VEHICLES USED TO TRANSPORT LIVESTOCK

Roof to protect animals against rains and sun					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	13	24.5	26.0	26.0
	No	37	69.8	74.0	100.0
	Total	50	94.3	100.0	
Missing	System	3	5.7		
	Total	53	100.0		

Sharp or Protruding Object that can injure animals					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	2	3.8	4.0	4.0
	No	48	90.6	96.0	100.0
	Total	50	94.3	100.0	
Missing	System	3	5.7		
	Total	53	100.0		

Holes, Gaps, or Cracks in the Floor					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	7	13.2	14.0	14.0
	No	43	81.1	86.0	100.0
	Total	50	94.3	100.0	
Missing	System	3	5.7		
Total		53	100.0		

Presence of bedding material on the floor					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	50	94.3	100.0	100.0
Missing	System	3	5.7		
Total		53	100.0		

Availability of ramps/laterals protection for loading/unloading					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	50	94.3	100.0	100.0
Missing	System	3	5.7		
Total		53	100.0		

Trucks with no side walls					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	41	77.4	82.0	82.0
	No	9	17.0	18.0	100.0
	Total	50	94.3	100.0	
Missing	System	3	5.7		
Total		53	100.0		

Partition/Individual compartment					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	50	94.3	100.0	100.0
Missing	System	3	5.7		
Total		53	100.0		

APPENDIX F: MORTALITIES OF ANIMALS RECORDED ON ARRIVAL AT THE KUMASI LIVESTOCK MARKET

Mortality of animals transported from different countries					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	16	59.3	69.6	69.6
	No	7	25.9	30.4	100.0
	Total	23	85.2	100.0	
Missing	System	4	14.8		
Total		27	100.0		

Mortality of animals transported within Ghana					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	6	22.2	22.2	22.2
	No	21	77.8	77.8	100.0
	Total	27	100.0	100.0	

APPENDIX G: VEHICLE CONDITION CLASSIFIED BASED ON SOME SUITABLE DESIGN ATTRIBUTES REQUIRED FOR LIVESTOCK TRANSPORT VEHICLES

TRUCK CONDITION					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	37	69.8	74.0	74.0
	Moderate	13	24.5	26.0	100.0
	Total	50	94.3	100.0	
Missing	System	3	5.7		
Total		53	100.0		

APPENDIX H: Socio-Demographic Characteristics of Livestock owners/caretakers at Kumasi Livestock market

Age Group					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 30	9	22.5	22.5	22.5
	31-40	9	22.5	22.5	45.0
	41-50	10	25.0	25.0	70.0
	51-60	12	30.0	30.0	100.0
	Total	40	100.0	100.0	

Highest academic qualification					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	JHS	10	25.0	25.0	25.0
	SHS	4	10.0	10.0	35.0
	No formal education	26	65.0	65.0	100.0
	Total	40	100.0	100.0	

Have you had training on livestock handling					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	18	45.0	45.0	45.0
	No	22	55.0	55.0	100.0
	Total	40	100.0	100.0	

APPENDIX I: QUESTIONNAIRE FOR MEAT CONSUMERS

1. Please indicate your town /nearest city.....
2. Please indicate your age group
 - a. Less than 20 b. 20-30 c. 31-40 d. 41-50 e. 51-60 f. Over 60
3. What is your gender?
 - a. Male . b Female
4. What is your marital status?
 - a. Single b. Married
5. What is your highest academic qualification?
 - a. GCSE/O-Level b. A-Level c. Graduate d. Postgraduate e. No formal education
6. What is your religion?.....
7. Does your religion specify how meat you eat, should be processed?
 - a. Yes b. No
8. Explain briefly, the response in question 7 above.....
9. Are you employed? a. Yes b. No
10. Do you know what stunning of livestock prior to slaughter means?
 - a. Yes b. No
11. Why do you think animals are stunned prior to slaughter.....?
12. In your opinion, do you think animals should be stunned before slaughter, or not? Explain your answer.....
13. Would you willingly patronize meat of animals that were stunned prior to slaughter? a. Yes b. No
14. Explain your answer?.....

15. Stunning has been reported to reduce the pain associated with slaughter. Do you agree with this statement? a. Yes b. No
16. Can you differentiate between meat of stunned and non-stunned animals?
- a. Yes b. No
17. Do you know what Halal meat is? a. Yes b. No
18. If yes, explain briefly what it is?.....
19. Does it matter to you, whether the meat you buy is a Halal or not?
20. Where do you usually buy your meat
- a. Any butcher in the market b. Muslim butchers in the market c. Cold store operators d. Anywhere at all I find meat
21. When purchasing meat, do you normally check the label or ask for information relating to product safety? a. Yes b. No
22. Animals may be pre-stunned or post-cut stunned Halal slaughter. Do you understand what these procedures means?
- a. Yes, I understand what pre-slaughter and post-cut stunned mean
- b. No I do not understand what pre-slaughter and post-cut stunning mean.
23. Which of the following is your preferred method of Halal slaughter (Assuming the slaughter is performed by a Muslim in all case)?
- a. Pre-stunned slaughter on conditioned that the animals was alive at the point its neck was cut
- b. Slaughter without stunning
- c. Post-cut stunned slaughter (This is where a live animal is slaughter followed by stunning)
- d. Indifferent

**APPENDIX J: : QUESTIONNAIRE ON STUNNING OF ANIMALS
PRIOR TO SLAUGHTER- OPINION OF ISLAMIC SCHOLARS**

1. Please indicate your town /nearest city

2. Please indicate your age group

a. Less than 20 b. 20-30 c. 31-40 d. 41-50 e. 51-60 f. Over 60

3. What is your gender?

a. Male . b Female

4. What is your marital status?

a. Single b. Married

5. What is your highest academic qualification?

a. GCSE/O-Level b. A-Level c. Graduate d. Postgraduate e. No formal education f. None of the above.

6. Are you employed? a. Yes b. No

7. Do you know what stunning of livestock prior to slaughter?.....

8. Why are livestock stunned prior to slaughter?.....

9. What is the opinion of the Islamic Religion, on stunning of livestock prior to slaughter?

10. Which of the following applies to you? You can choose more than one

a. I always eat Halal meat b. I sometimes eat non-Halal meat c. I never eat non-Halal

11. Which of the following applies to you?

a. I always purchase meat that is certified as Halal b. I sometimes purchase uncertified meat if the butchers/seller can vouch for the Halal status c. I sometime buy non-Halal meat but not pork

12. Where do you normally purchase your meat?
- Local Muslim butchers
 - Muslim butchers in mainstream supermarkets.
 - Directly from the Halal abattoir
 - Non-Muslim butchers.
13. When purchasing Halal meat, do you normally check the label or ask for information relating to product safety. a. Yes b. No
14. Which of the following is your preferred meat?
- Beef
 - Mutton/Chevon
 - Poultry (e.g. chicken, turkey)
15. Animals may be pre-stunned or post-cut stunned Halal slaughter. Do you understand what these procedures means?
- Yes, I understand what pre-slaughter and post-cut stunned mean
 - No I do not understand what pre-slaughter and post-cut stunning mean.
16. Does the Islamic Religion permit hunting and consumption and of game animals? a. Yes b. No
17. If animals were stunned prior to slaughter, which information would you expect on the label
- The method of stunning used (e.g. electrical mechanical or gas)?
 - An indication of the reversibility of the stunning system (Reversible stunning is one which may not result in the death of animal and animals may recover if the slaughter cut were not carried out)
 - The compliance of the methods of stunning with EU legislative requirements

- d. The logo of the Halal Certification Body which approved the product (if the meat is certified)
- e. Not applicable- I do not purchase meat from stunned animals

APPENDIX K: QUESTIONNAIRE ON SOME WELFARE ASPECTS OF ANIMALS DURING TRANSPORTATION AND SLAUGHTER AT SELECTED LIVESTOCK MARKETS IN GHANA.

Drivers/Transport.

1. Please indicate your age group
 - a. Less 30 b. 31-40 c. 41-50 d.51-60 e. Over 60
2. What is your highest academic qualification?
 - a. JHS b. SHS c. Graduate d. Postgraduate e. No formal education
3. Have you had any training on livestock handling?
 - a. Yes b. No
4. Briefly explain your response in 3 above (if yes).....
5. Where do you usually buy your animals?.....
6. Where do you transport the animals to?.....
7. What species of the animals do you transport? (Choose one or more)
 - a. Cattle b. Sheep c. Goat d. Pigs e. Others (please specify)
8. What time of the day you set off from the place of livestock purchase to the sales point?
9. Briefly give reason for your response in 7 above.....
10. Have you hand any training on livestock transporting?.....

11. Do you have a route plan, thus specific route for the trip to your destination?
a. Yes b. No
12. While in transit do you stop at staging points?
a. Yes b. No
13. How many times do you stop per trip?.....
14. How many hours/minutes do you spend at the stop points?.....
15. While in transit do animals have access to feed?
a. Yes b. No
16. If yes to Q16, what type of feed are the animals given?.....
If no, why not?.....
17. While in transit do the animal have access to water?
a. Yes b. No
18. Before loading animal onto a truck what measures do you put in place to minimise fighting?.....
19. When transporting animals what documents do you carry along?
.....
20. Do you experience mortality on arrival?.....
If yes, how often?.....
21. If yes do you conduct post mortem examination on dead animals?.....
22. What is the average number of animals that die per trip?.....

APPENDIX L: QUESTIONNAIRE ON SOME WELFARE ASPECTS OF ANIMALS AT KUMASI LIVESTOCK MARKETS.

Animal owner/caretakers at the livestock market

1. Please indicate your age group
 - a. Less 30 b. 31-40 c.41-50 d. 51-60 e. Over 60
2. What is your highest academic qualification?
 - a. JHS b. SHS c. Graduate d. Postgraduate e. No formal education
3. Have you had any training on training handling?
 - a. Yes b. No
4. Briefly explain your response in 3 above (if yes).....
5. Where are the animals kept after unloading?.....
6. Does the place mentioned in 2 above have a shelter against harsh weather conditions?.....
7. While animals are kept in this place do you feed them?
 - a. Yes b. No
8. While animals are kept in this place do you feed them?.....
 - a. Yes b. No

If yes, what feed do you feed this them?.....
9. How often provide water for the animals?.....
10. Do you provide water for the animals?.....
11. How often do you provide water?.....
12. What is the source of water?.....
13. Do you encounter mortality during the period?.....

14. What is the cause for the mortality during this period?.....
 15. How often do animals die?.....
 16. How long do the animals stay at the said place mentioned?.....
 17. Suggest ways in which your business could be improved?.....
-

APPENDIX M: QUESTIONNAIRE ON THE USE OF STUNNERS-OPINION OF THE BUTCHERS.

1. Please indicate your age group
 - a. Less than 30 b. 31-40 c. 41-50 d. 51-60 e. Over 60
2. What is your highest academic qualification?
 - a. JHS b. SHS. c. Graduate d. Postgraduate e. No formal education
3. Have you had any training in livestock slaughter?
 - a. Yes b. NoIf yes by which organization?.....
4. Briefly explain your responses in 3 above (if yes)
5. What species of animals do you slaughter?
 - a. Cattle b. sheep. c. Goat d. Pigs e. Other (please specify)
6. Do you stun your animals prior to slaughter?.....
7. Explain you answer.....
if yes, why do you stun your animals prior to slaughter?
if no, why don't you stun prior to slaughter?
8. What type of humane slaughter equipment do you use?.....
9. Is the equipment mentioned do you slaughter?.....
 - a. Captive bolt stunner b. Electronic stunner c. Other (please specify)