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Research

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Simbil Benjamin Yenoah, Benjamin Obukowho Emikpe, Derrick Adu Asare, Edmond Onidje, Asenso Nyarko Timothy, Essel-Cobbinah Daniel

Corresponding author: Benjamin Obukowho Emikpe, School of Veterinary Medicine, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. banabis2001@yahoo.com

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Benjamin Yenoah Simbil[1], Benjamin Obukowho Emikpe[2,&], Derrick Adu Asare[2], Edmond Onidje[3], Timothy Nyarko Asenso[2], Daniel Cobbinah-Essel[2]

[1]Department of Animal Science, Faculty of Agriculture, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana, [2]School of Veterinary Medicine, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana, [3]Pan African University Life and Earth Sciences Institute (including Health and Agriculture), Ibadan, Nigeria

&Corresponding author

Benjamin Obukowho Emikpe, School of Veterinary Medicine, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Abstract

Introduction: the transportation of cattle to slaughterhouses is a critical aspect of the livestock supply chain, yet there is a significant lack of understanding regarding the logistics involved, particularly in Ghana. This study addresses the urgent need for research into the transportation systems and animal welfare practices associated with cattle supply to the Kumasi Abattoir. The aim is to quantify the relationship between transport distance and cattle mortality rates, which has not been adequately explored in the current literature. Methods: a cross-sectional survey was conducted involving 100 purposively selected truckers, utilizing a structured questionnaire to collect data on vehicle design, distance traveled, mortality rates, and transportation challenges. Statistical analyses were performed using SPSS version 21 to analyze the data. Results: the study indicated that trailers were the predominant vehicle type used (64%), with an overall cattle mortality rate of 11.65%. Significant associations were found between vehicle type, transport distance, and mortality rates (p < 0.05). The study identified critical transportation issues, including overcrowding, poor road conditions, and delays caused by police, which negatively impact animal welfare. Conclusion: the findings highlight the urgent need for improved transportation practices to enhance animal welfare and reduce mortality rates. Implementing better vehicle designs and management strategies is essential for fostering a sustainable meat production system in Ghana, ultimately benefiting both livestock producers and consumers.

Introduction

The production of cattle is an integral part of economic development strategies in many countries, making a vital contribution not only to increased food security but also to the livelihood development of both small and large-scale farmers. Cattle provide basic products such as milk and meat, which are essential for nutrition, and they also serve as a significant source of income for farmers; therefore, their contribution to the improvement of food access is both direct and indirect [1]. However, animal welfare during the transportation and slaughter of cattle is a critical issue that influences both the animals' well-being and the quality of the produced meat, as stated by Bhatt *et al.* [2] and Gobena *et al.* [3]. The process of transporting cattle subjects them to a range of stressors, such as substandard handling practices, insufficient loading techniques, inadequately designed vehicles, and unfavorable environmental conditions. Such elements can trigger both physiological and oxidative stress, resulting in modifications in behavior, heightened mortality rates, carcass injuries, loss of body weight, and changes in meat pH [4-6]. These results not only reduce the quality of meat but also lead to financial setbacks throughout the livestock value chain [7].

In the West African region, especially in Ghana, the transportation of cattle plays a crucial role within the livestock supply chain, involving extensive journeys from adjacent nations including Burkina Faso, Mali, and Niger to prominent slaughter facilities such as the Kumasi Abattoir [8,9]. The transportation logistics of cattle often come with challenges, such as the need to work for long hours under unfavorable conditions and frequent breakdowns of vehicles, which heightens levels of stress and negatively impacts animal welfare during the transportation process. In some regions, cattle are traditionally transported by trekking, with inadequate feeding or watering, thus compromising their welfare and resulting in decreased quality of meat [10].

Given Ghana's estimated cattle population of 3 million as of 2020, efficient logistics and transportation systems are critical to linking farms with markets and slaughterhouses [9]. Proper planning that considers animal characteristics and transportation factors is essential to minimizing production losses and enhancing meat quality [6]. Notwithstanding the significant importance of cattle transportation within the livestock value chain in Ghana, the specific logistics associated with this process remain poorly understood, especially

regarding the relationship between transport distance and cattle mortality rates, which has yet to be adequately quantified in the context of Ghana. Furthermore, there has been a lack of attention devoted to animal welfare during the transportation process, encompassing aspects such as handling practices and the design of vehicles. The present research attempts to assess the transport systems and the characteristics of cattle supply to the Kumasi Abattoir in Ghana, trying to establish how transport distance is related to rates of cattle mortality, in addition to giving insights and recommendations for improving animal welfare and operational efficiency in the livestock value chain.

Methods

Study area: the research was carried out at the Kumasi Abattoir, which is found in the Ashanti Region of Ghana. The Kumasi Abattoir stands in Ghana as one of the abattoirs where animals predominantly come from farms both nationally and internationally, after taking an extended period in transit. Animals that are to be slaughtered in the Kumasi Abattoir come from different regions in Ghana, such as Yeji in Brong Ahafo and northern territories of Ghana, and even from neighboring countries like Burkina Faso, Mali, and Niger. The geographical coordinates of the Kumasi Abattoir are 6039136.611N latitude and 1036115.411W longitude. The abattoir is 150 meters away from the cattle market. Next to this market are kraals where the animals are kept while sales are being made. Next to these kraals is a holding pen for cattle destined for the abattoir and about 10 meters from the holding pen where the cattle are kept overnight before being slaughtered the following morning.

Sampling technique and sample size: a purposive sampling method was used to select only truckers who transport cattle to Kumasi Abattoir. This method was adopted in a bid to ensure that participants in this study would be those who were directly involved in the logistics and challenges of cattle transportation. The sampling frame involved all active animal transporters operating in the cattle market, thus providing a fair base from which participants could be drawn. In this respect, 100 truckers were randomly selected to participate in the study. Such an approach was used to ensure that participants of the sample would represent cases of direct experience and knowledge of the logistics, challenges, and related animal welfare issues of cattle transportation.

Data collection: data was collected through the administration of a structured questionnaire to truckers transporting cattle into the Kumasi Abattoir. The questionnaires were used to solicit in-depth information from the demographic characteristics of the truckers, like age, experience, and education. It also focused on vehicle types, any modifications, materials used in the transportation of cattle, and practices related to animal resting, attendant availability, duration of transport, and average number of cattle per trip. This was further complemented by information on cattle mortality during transit: the number of deaths, causes, and timing of such incidents.

Data analysis: the data were analyzed using SPSS version 21.0. Descriptive statistics were used to summarise relevant variables such as demographic profiles, vehicle types, and cattle mortality. To evaluate the correlation between cattle mortality and transport distance, as well as the association between the unit area per cattle and mortality rates, the student t-test was conducted. The results of the significance test were significant at a 5% level (p 0.05), suggesting a strong correlation between these factors and an increase in cattle mortality during transportation. Significance was tested at a 5% level (p < 0.05), with significant results indicating a strong relationship between these factors and increased cattle mortality during transportation.

Results

The study uncovered several significant findings related to the demographic characteristics of

truckers, the breeds and origins of the cattle they transport, their transportation practices, and the factors influencing cattle mortality during transit. As detailed in Table 1, the majority of truckers (67%) were between the ages of 31 and 40, with smaller proportions in the 21-30 age group (9%) and the 41-50 age group (24%). Most truckers (86%) identified as Muslim, while 14% were Christian. Educationally, 24% had no formal education, 69% had completed basic education, 5% had secondary education, and only 2% had tertiary education.

In terms of the breeds of cattle transported, Figure 1 illustrates that N´dama was the most commonly transported breed, reported by 91% of the truckers. This was followed by White Fulani (62%), Sokoto Gudali (40%), Zebu (22%), and WASH (12%). The majority of cattle were sourced from Ghana (63%), with 36% coming from Burkina Faso, and smaller numbers from Mali (5%) and Niger (2%), as shown in Figure 2.

Transportation practices among the truckers varied, with 64% using trailers, 31% using cargo vehicles, and 5% using trucks. Table 2 indicates that most vehicles (97%) were made entirely of metal, with only 3% incorporating both metal and wood. A significant number of truckers (90%) reported not resting the animals during transport, while 10% did provide rest. Attendants were present during 79% of the trips. Most truckers (90%) completed their journeys within 24-48 hours, with 56% transporting an average of fifty cattle per trip, while 44% transported fewer. Additionally, 89% of truckers transported cattle during both the dry and rainy seasons, with 7% transporting exclusively in the dry season and 4% in the rainy season.

Table 3 presents additional information on transportation practices, including the resting of animals, the presence of attendants, transport duration, and the average number of cattle transported per trip. The data show that a significant number of truckers (90%) did not rest the animals during transport, while 10% did provide rest. Attendants were present on 79% of the trips,

emphasizing the importance of human supervision during transportation. Most truckers (90%) completed their journeys within 24-48 hours, with 56% transporting an average of fifty cattle per trip, while 44% transported fewer. Furthermore, 89% of the truckers transported cattle during both the dry and rainy seasons, with 7% transporting exclusively in the dry season and 4% in the rainy season. As depicted in Figure 3, truckers faced several challenges during transportation. Overcrowding of cattle, poor road conditions, and delays caused by the police were identified by 17% of respondents as significant issues. Additionally, 15% of truckers reported challenges related to overcrowding and police pressure, while another 15% highlighted animal stress due to overcrowding. Overloading and vehicle malfunctions were reported by 6% of truckers, and 1% cited the presence of unfamiliar animals as a problem during transportation.

Cattle mortality during transportation was a key focus of the study, serving as an indicator of the stress experienced by the animals. As shown in Table 4, the overall cattle mortality rate during transportation was 11.65%. Mortality rates were influenced by various factors, including the type of vehicle used, the distance traveled, and the unit area per cattle. Trailers, which on average covered longer distances (585.44 km), recorded higher total mortality (40 deaths) compared to cargo vehicles, which recorded 18 deaths. Cargo vehicles, with an average area per cattle of 0.77m², had a mortality rate of 6.43%, while trailers, with a larger average area per cattle of 1.65 m², had a slightly lower mortality rate of 5.22%. Statistical analysis using the Student t-test revealed significant associations between the type of vehicle and the mortality rate (P = 0.000248), as well as between the distance traveled and the total number of cattle mortalities (P < 0.000).

Discussion

The present study assessed the transport systems and characteristics of cattle supply to the Kumasi Abattoir in Ghana, attempting to establish how

transport distance is related to rates of cattle mortality. It was observed that a greater proportion of truckers, 67% were between the ages of 31 and 40 while 9% were within the age bracket of 21-30 years. This age distribution is consistent with previous studies, such as that by Mogre *et al.* [9], which reported the same age bracket for truckers in the transportation of livestock in Ghana. This is further emphasized by Aboah *et al.* [11], who asserted that the majority of cattle market actors, notably transporters, typically possess minimal formal education. The demographic profile of this study, which is characterized by a high proportion of middle-aged truckers with limited formal education, suggests that they are less effective in the handling of cattle transportation due to their lack of formal training and their reliance on traditional practices and native Indigenous knowledge. The result also corroborates the studies of González *et al.* [12] and Valadez-Noriega *et al.* [13], who noted similar trends, highlighting the need for targeted training and education to improve transportation practices and animal welfare.

The dominance of the N´dama breed (91%) among the cattle transported is in line with previous studies, such as the one by Kubkomawa [14], which highlighted the prevalence of indigenous breeds in West Africa due to their disease resistance. However, the sourcing of cattle predominantly from Ghana (63%) and Burkina Faso (36%) reflects the established trade patterns noted by Rich and Wane [15], where Burkina Faso is a major supplier of cattle to Ghana.

Stocking density emerged as a critical factor in this study, with smaller cargo vehicles transporting fewer cattle compared to trailers. This finding aligns with earlier studies, particularly within West Africa, while also highlighting critical areas of concern. The predominant use of trailers by 64% of truckers reflects practices documented by Mogre *et al.* and Aboah *et al.* [9,11], who noted the economic efficiency of trailers for transporting large numbers of cattle. In contrast, the smaller capacity of cargo vehicles underscores the importance of managing

stocking density to minimize stress and injury, as emphasized by Jongman and Butler [16]. The prevalent use of metal in vehicle construction, although durable, raises significant concerns about the potential for injury due to wear and tear, echoing the findings of Wambui *et al.* [17] and Mogre *et al.* [9]. This practice contrasts with those in more regulated environments, where vehicles often feature padded or non-slip surfaces designed to enhance animal welfare [18].

The high mortality rate of 11.65% reported in this study, particularly associated with longer transport distances and inadequate vehicle conditions, is significantly higher than rates documented in more controlled environments, such as those discussed by Valkova *et al.* [19]. This rate indicates a pressing need for improved transportation practices, a point also emphasized in studies focused on calf transportation. Creutzinger *et al.* [20] and Goetz *et al.* [21] explored the impacts of long-distance transport on young dairy calves, finding that extended travel times without appropriate rest or care significantly compromise animal welfare, leading to increased morbidity and mortality. These findings are mirrored in this study's observations, further highlighting the critical need for rest periods and improved vehicle conditions to reduce stress and mortality during transport.

Challenges such as overcrowding, poor road conditions, and police delays, reported by transporters in this study, are consistent with the broader structural issues identified by Aboah *et al.* [11] in Nigeria's cattle value chain. These challenges not only increase transportation costs but also significantly contribute to the inefficiency of the supply chain, ultimately affecting the competitiveness of the livestock sector.

Study limitation: several limitations are inherent in this study and thus need to be considered when interpreting the results. The focus of this study was on truckers involved in cattle transportation to the Kumasi Abattoir and may not reflect cattle transportation practices throughout Ghana or in any other region. In addition, the study used self-

reported information provided by the truckers, which is subject to recall bias and intentional misreporting, especially on sensitive issues related to the number of mortalities and transportation practices. Furthermore, the research design is cross-sectional; thus, it provides only a snapshot of one point in time, for which seasonal variations or changes in practices cannot be accounted.

Conclusion

The research findings indicate that the transportation of cattle to the Kumasi Abattoir is fraught with significant challenges that adversely affect both animal welfare and economic efficiency. The study revealed high mortality rates during transit, largely influenced by factors such as the type of vehicle used, the distance traveled, and the lack of proper resting periods for the animals. Additionally, the predominant use of poorly designed vehicles and the inadequate handling practices reported by truckers contribute to the stress and injuries experienced by the cattle. These factors not only compromise the quality of the meat but also result in substantial economic losses. Given these findings, it is evident that improvements in transportation logistics, vehicle design, and training for truckers are essential to enhancing animal welfare and ensuring more sustainable and economically viable cattle transportation practices in Ghana.

What is known about this topic

- *The issue with cattle transportation: problems like vehicle design and overloading create stress in animals, injuries, and degraded animal welfare and meat quality;*
- *Economic implications: poor transportation conditions result in a vast loss due to the mortality of the cattle and poor-quality meat as a result of changes related to stress within them;*

- *Importance of vehicle design and training: vehicles designed accordingly and trained personnel are substantial elements in enhancing animal welfare at transport, better quality of meat, and lessening economic losses.*

What this study adds

- *Discovers association of mortality with transport distance: the clarity of evidence from this study provides evidence that long distances of transport increase cattle mortalities, especially when combined with inappropriate vehicle design and lack of rest stops;*
- *Calls into question the effectiveness of the present logistics: it evidences that, besides being harmful to the animals, the current means of transport cannot be economically sustained and affect altogether the viability of the cattle industry in Ghana;*
- *Urgent calls for reforms that presuppose improved vehicle standards, better training for transporters, and more stringent regulations, especially with respect to long-distance transportation impacts on mortality in cattle.*

Competing interests

The authors declare no competing interests.

Authors' contributions

Benjamin Obukowho Emikpe conceptualized and designed the study. Benjamin Yenoah Simbil and Timothy Nyarko Asenso managed data collection. Derrick Adu Asare and Edmond Onidje drafted the questionnaire analyzed and interpreted the data and drafted the manuscript. All authors have read and approved the manuscript for publication and have full responsibility for the accuracy and integrity of the work.

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Figure 2: source of cattle transported by respondents to the Kumasi Abattoir

Figure 3: problems encountered by respondents during transport of cattle

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Table 1: demographic characteristics of respondents

Characteristics	Categories	Frequency	Percentage (%)
Age	21-30	9	9
	31-40	67	67
	41-50	24	24
Educational background	Basic	69	69
	Senior high school	5	5
	Tertiary	2	2
	No formal education	24	24
Religion	Christian	14	14
	Muslim	86	86

Table 2: overview of vehicle characteristics, transportation practices, and cattle handling during transit

Variable	Sub-variable	Frequency	Percentage (%)
Vehicle type	Cargo	31	31
	Trailer	64	64
	Truck	5	5
Vehicle material	Metal	97	97.0
	Metal and wood	3	3
Platform material	Wood	65	65
	Metal	15	15
	None	20	20
Resting of cattle in transit	Yes	10	10
	No	90	90
The presence of attendants in transporting cattle	Yes	79	79
	No	21	21
Time taken to transport animals	Less than 24 hours	10	10
	24-48 hours	90	90
The average number of cattle transported	50	56	56
	Less than 50	44	44
Seasonality of cattle transportation	Rainy	4	4
	Dry	7	7
	Both	89	89

Table 3: cattle mortality during transportation by vehicle type

Type of Vehicle	Total number of cattle transported	Total Mortality	Mortality (%)
Cargo (n=7)	280	18	6.43
Trailer (n=16)	766	40	5.22
Total	1046	58	11.65

Table 4: effects of transport distance and vehicle area on cattle mortality

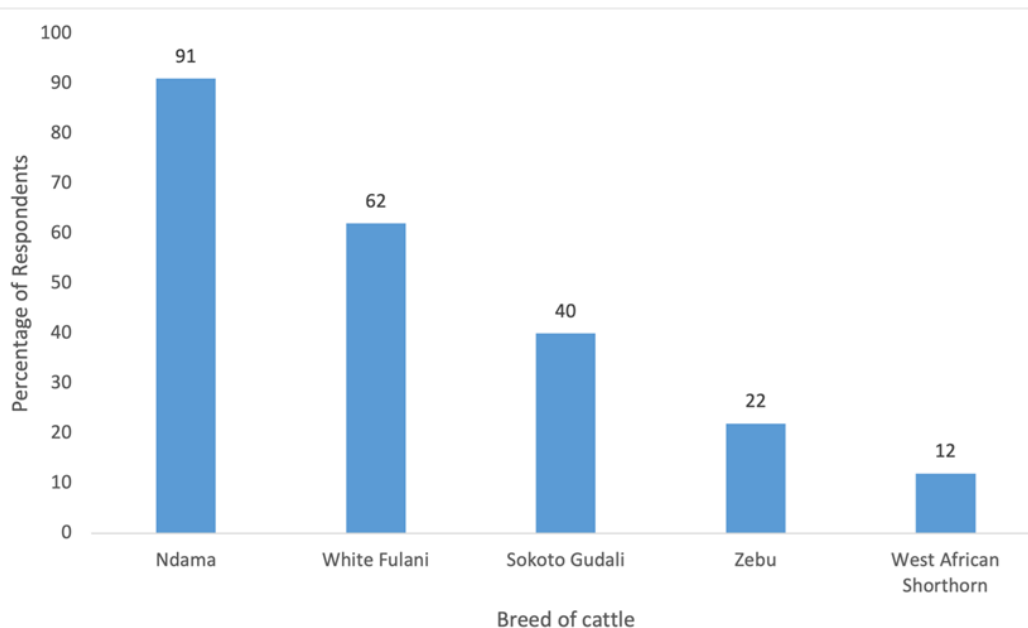| Vehicle area and cattle mortality				
Type of vehicle	The average area of the vehicle (m²)	Average area per cattle/vehicle (m²)	Mortality (%)	P-value
Cargo (n=7)	30.64	0.77	6.43	0.000248
Trailer (n=16)	79.04	1.65	5.22	
Transport distance and cattle mortality				
Type of vehicle	Average distance traveled (km)		Total mortality	P-value
Cargo (n=7)	374.14		18	<0.000
Trailer (n=16)	585.44		40	

Figure 1: breed of cattle transported by respondents
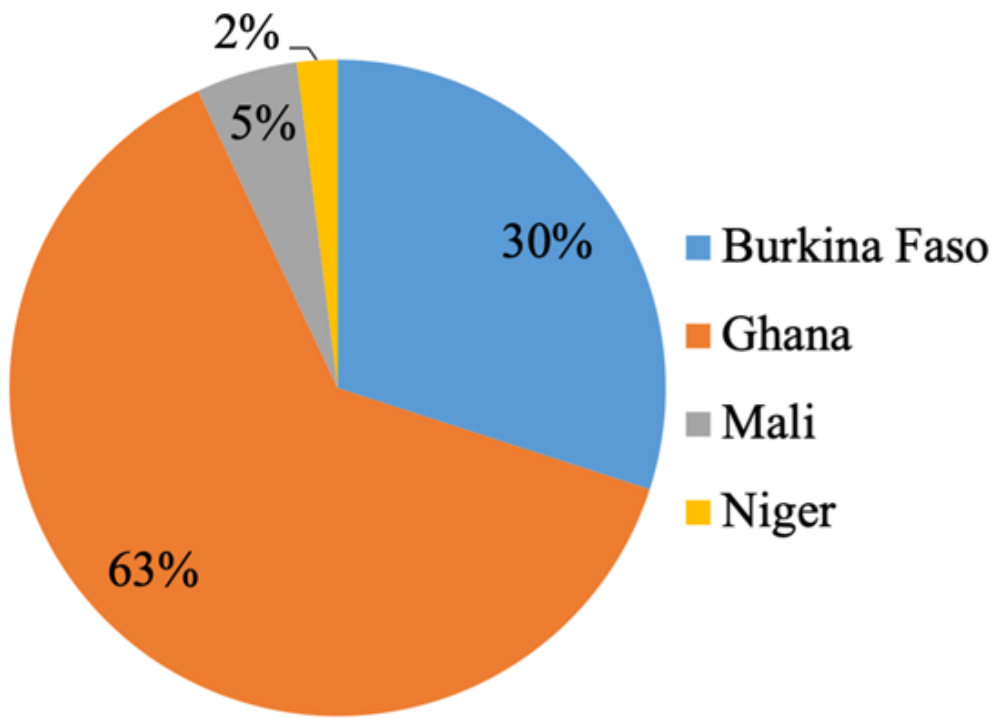
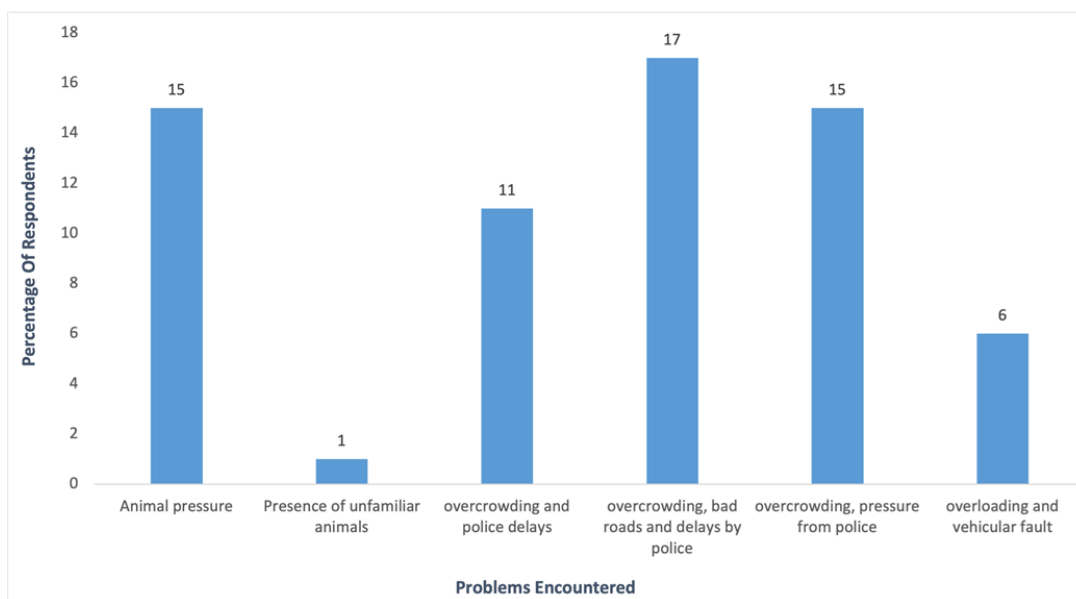**Figure 2**: source of cattle transported by respondents to the Kumasi Abattoir

Figure 3: problems encountered by respondents during transport of cattle