Original Article

Sahel Journal of Veterinary Sciences

Sahel J. Vet. Sci. Vol. 20, No. 3, Pp 46-52 (2023)
http://doi.org/10.54058/saheljvs.v20i3.403

Article History
Received: 30-07-2023
Revised: 26-09-2023
Accepted: 29-09-2023
Published: 29-09-2023

Fetal Wastages Among Food-producing Animals Slaughtered at Maiduguri Abattoir: Prevalence, Causes and Economic Implications

[1*]Jajere, S. M., [1]Mohammed, S., [1]Jidda, D. and [1]Emmanuel, E. T.

[1] Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Maiduguri, Nigeria.

[*] *Author for Correspondence: drmsjajere@unimaid.edu.ng*

ABSTRACT

This study aimed to explore the occurrence of fetal wastage and its economic implications using a seven-year (2014 – 2020) retrospective Maiduguri abattoir records. A semi-structured questionnaire was also administered to butchers on the reasons for slaughtering of pregnant animals. Economic losses were also estimated. Of the 287563 female animals slaughtered during the study period, 53 797 (18.7%) fetal wastages were recorded with species-specific prevalences of 12% (n=10137), 9.5% (n=33458), 17.4% (n=13442) and 28.3% (n=26760) for calves, camel calves, lambs, and kids respectively. There was statistically significant association ($p< 0.05$) between season, species of slaughtered food-producing animals and the occurrence of fetal wastage. About N2.889 billion ($3,675,771), N985.5 million ($1,253,884.5), N1.277 billion ($1,624,344) and N762.660 million ($971,120.4) for cattle, camel, sheep and goat respectively were lost, that could have accrued if the fetuses have survived and reached market value as adults. Additionally, 1 213 380 kg of beef, 397 485 kg of camel meat, 357 560 kg of mutton and 564 368.4 kg of chevon valued at N3, 640,140,000 ($4,610,844), N1, 192,455,000 ($1,510,443), N1, 251,460,000 ($1,609,020) and N1, 975,289,400 ($2,539,657.8) respectively were also lost. Majority of the factors leading to the slaughter of pregnant food-producing animals were disease conditions, economic hardship, ignorance of the pregnancy status of the animal and feed scarcity during dry season. Therefore, it is imperative to reduce this practice through proper screening test, advocacy and public enlightenment campaigns for the need of pregnancy status assessment using an affordable, user-friendly rapid test kits at farms, livestock markets and abattoirs.

Keywords: Economic losses; Fetal wastage; Maiduguri abattoir; Pregnant food-producing animals; Prevalence

INTRODUCTION

Despite slight increase in the livestock production in developing countries such as Nigeria (Schonfeldt and Hall, 2012), the livestock proteins annual supply growth rates are insufficient to meet the demand of the teaming human population of more than 200 million in Nigeria (Alhaji *et al*., 2015; Worldometer, 2023). Food and Agriculture Organization of the United Nation (FAO) in 2014 has reported that Nigeria has ruminant livestock resources of cattle, sheep, and goat estimated at 19.2 million, 38.5 million and 57.4 million respectively (FAO, 2014). Similarly, in 2023 Nigeria was placed sixth in the world ranking of camel,

with projected population of about 223.8 million heads (FAO, 2014). Although, FAO in 2013 recommended daily intake of 41.9 kg animal proteins per person, in Nigeria intake of high-quality livestock proteins in most household is below 9 kg which is more than four times below the recommended quantity with consequence of malnutrition in children.

However, there was stable growth in food animals' demand, which increases the price of meat package; this resulted in unethical practices of slaughtering actively breeding livestock and pregnant animals in a significant number of Nigerian abattoirs (Ugwu *et al.,* 2023). Therefore, in order to increase meat production, it is expedient to identify factors militating against meat production in Nigeria, one of which is the common and unhealthy practice of slaughtering pregnant livestock in abattoirs. The slaughter of pregnant livestock species as the major source of animal proteins will worsen the unstable supply of animal protein to the populace (Njoga *et al.,* 2021). Though, it is most uneconomical to continue the practice of slaughtering pregnant food-producing animals, a situation that significantly posed a great threat to livestock population in Nigeria (Chama *et al.,* 2019). Prevention of these negative practices of fetal wastages in various abattoirs in Nigeria may greatly increase the livestock population and ensure stable animal protein supplies to the populace (Ugwu *et al.,* 2023). Awareness of the degree of livestock fetal wastage in

the abattoir in the study area is necessary in decision-making. It is against this contextual reason that this study was developed. The current study assessed the occurrence, causes and economic implications of fetal wastage caused by slaughtering pregnant livestock species. It also highlighted the negative effects of the persistence of such practices in the study area and Nigeria in general.

MATERIALS AND METHODS

Study Area

The study was conducted at the Maiduguri abattoir located near the main livestock market within Maiduguri Metropolis. Maiduguri is the capital of Borno State, Nigeria and the largest city in the northeastern part of Nigeria with a landmass cover of 132km^2 with a population density of 5,543.2 inhabitants per km^2 projected in 2015.The study area Maiduguri is located on latitude 11.8311° north and longitude 13.1510° east of the equator. It has the main livestock market that supplies animals for slaughter in the abattoir and used to be one of the biggest livestock markets in the Northeastern region of the country according. In the recent past, livestock trading was being affected by the humanitarian crises, which resulted in declined in the slaughtered livestock figure. The animals traded in the market are mostly sourced from within the country and few from Chad, Sudan, Cameroon and Niger Republic. The climate is semi-arid with about two climatic seasons that includes wet season (from April to October) and the dry season (from November to March).

Study Design

A retrospective study of fetal wastage among food-producing animals (Camel, Cow, Sheep and Goats) slaughtered at Maiduguri abattoir was carried out. Records were obtained from the abattoir record books (NADIS/IBAR diseases' reporting network) at the Maiduguri abattoir. Slaughtered pregnant food-producing animals at the abattoir for the period between 2014 and 2020 were considered as cases for the study.

Determination of Prevalence

The monthly prevalence rate, annual prevalence rate, and the overall prevalence rate of the fetal wastage were computed as follows:

Monthly prevalence = Fetal wastage recorded during the month/Total number of female food-producing animals of reproductive age slaughtered in that month

Annual Prevalence = Fetal wastage recorded during the year/Total number of female food-producing animals of reproductive age slaughtered in that year (expressed in %)

Overall prevalence = Total number of fetal wastages recorded over the total years under investigation/Total number of female food-producing animals of reproductive age slaughtered for all the years (expressed in %)

The seasonal prevalence rate was also determined by calculating the number of fetal wastage cases recorded during the wet season (June – early October) and the dry season period (November – late April) and presented in percentages.

Factors responsible for the slaughter of pregnant food-producing animals

Information on factors responsible for slaughter of pregnant food-producing animals was elicited through administration of a close-ended questionnaire across a randomly selected (n=120) slaughterhouse workers/butchers working at the Maiduguri abattoir. A close-ended questionnaire was adopted with slight modification from a similar previous study (Njoga *et al.*, 2021; Ugwu *et al.*, 2023). Oral informed consents were first obtained from the abattoir workers followed by briefing on the implications of the study.

Estimation of Losses due to Slaughter of Pregnant Food-Producing Animals

The estimation of economic losses due to fetal wastage resulting from the slaughter of pregnant food-producing animals was estimated in monetary terms as revenues that would be realized from the sales of food-producing animals at maturity. The amount of meat that would have accrued from the wasted fetuses was estimated based on 63% (PennState Extension, 2021), 60.3% (Salehi *et al.,* 2014), 56% (Mahgoub and Lodge, 1998) and 74% (Ugwu *et al.,* 2023) carcass yields (inclusive of offals) for cattle, camel, sheep and goats respectively, and an average maturity live weight. The average weight was estimated at 200 kg, 200 kg, 50 kg and 30 kg for cattle, camel, sheep and goats respectively. We assumed that the fetuses would be born alive, raised to maturity, 5% pre-maturity mortality and costs associated with raising fetuses to maturity were also considered as described elsewhere (Ndi *et al*., 1993; Casey *et al.*, 2003). The monetary value was estimated in Nigerian currency, naira (₦) and converted to US Dollar ($) based on the official (Central Bank of Nigeria) exchange rate of ₦786 per US Dollar as at July 2023. Gross revenue losses associated with wastages were determined based on the minimum market prices of ₦300, 000 ($381.7), ₦300, 000 ($381.7), ₦100, 000 ($127.2) and ₦30, 000 ($38.2) for cattle, camel, sheep and goats respectively, similarly, the price of 1 kg of meat at ₦3000 ($3.8), ₦3000 ($3.8), ₦3500 ($4.5) and ₦3500 ($4.5) for cattle, camel, sheep and goats respectively.

Data Analysis

Data generated from the current study were first entered into the Microsoft Excel® 2010 and presented using descriptive statistics in the form of frequency tables and percentages. For further statistical analysis, the data were later imported into IBM® SPSS Statistics version 20 (IBM, Armonk, NY: IBM Corp.). In order to determine the association between fetal wastage and other independent variables such as years, months and season, Chi-square (χ^2) test was employed. Values of $p \leq 0.05$ were considered statistically significant.

RESULTS

The result of the study revealed that 287 563 female food-producing animals were slaughtered during the study period (2014-2020). The overall prevalence of 18.7% was recorded (Table 1). Does recorded the highest prevalence of 28.3%, while camel had the lowest 9.5% (Table 1). This study documented statistically significant ($p < 0.05$) association between fetal wastage and species of food-producing animals slaughtered in the study area (Table 1).

The cumulative annual prevalence of fetal wastage in slaughtered food-producing animals over the seven – year period under investigation documented high percentage in 2017 among Sheep and Camel with 26.3% and 13.7% respectively, while cows recorded higher prevalence of 14.6% in 2014 (Table 2). Similarly, Goats with the highest slaughtered figure recorded the highest prevalence of 38.1% in 2019 (Table 2). The highest cumulative frequency of fetal wastage was recorded in the month of September to October in all the studied species except the camel, which recorded low frequency (Figure 1). The months of January to March recorded the lower cumulative occurrence of fetal wastage (Figure 1). The month-wise prevalence of fetal wastage revealed that Does had high fetal wastage in the months of May (34.3%) and August – October (33.4 – 40.5%), Lambs in the months of June (19.1%) and August – September (22.2 - 27.7%), Camel calves in the month of March (12.9%) and November (12.8%) and lastly, Calves in the months of September and October with 19.6% and 18.7% respectively (Figure 1).

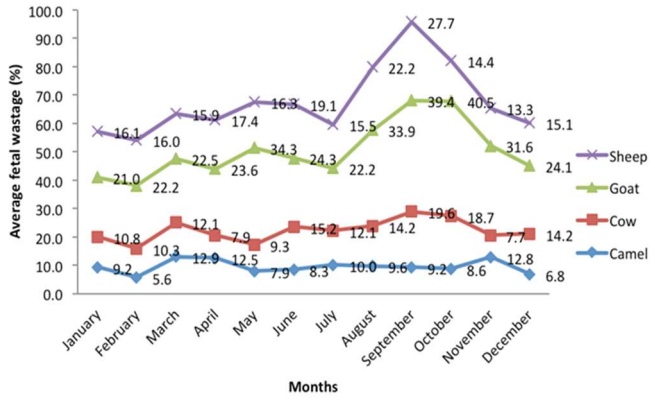

Figure 1: Cumulative trend prevalence of fetal wastage among different species of food-producing animals slaughtered in Maiduguri abattoir, Northeastern Nigeria (2014-2020).

The study recorded higher prevalence of fetal wastage among food-producing animals slaughtered during the wet season among Goats, Sheep, Cattle and Camel with prevalence rates of 32.5%, 17.8%, 13.4% and 9.8% respectively (Table 3). There was a statistically significant association ($p<0.05$) between season and fetal wastage among all the slaughtered food-producing animal species (Table 3). Table 4 shows the monthly distribution of slaughter figures and fetal wastages across the food-producing animals intended for slaughter at Maiduguri abattoir. The monthly slaughter figures demonstrated similar trends across the different species of the food-producing animals with an increasing trend observed from the months of May to August, September to December, May to July respectively documented for Camels, Cattle and Sheep (Table 4). Although there was no observed regular pattern or trend among Goats highest slaughter figure was documented in the month of December as was similarly demonstrated by Sheep. However, for the fetal wastage data, an increasing trend was observed in the month of May to July and July to October for Camels and Cattle. However, the data for Sheep and Goat was irregular without any pattern with the highest fetal wastages documented during the month of May in Goats (Table 4).

Table 5 depicts the factors or reasons responsible for the slaughter of pregnant food-producing animals in the study area. The distribution of abattoir workers according to the food-producing animals involved is 51 (42.5%), 36 (30%) and 33 (27.5%) for butchers working on cattle, camel and sheep/goats respectively. Vast majority of the slaughterhouse workers or butchers identified economic hardship (n=120; 92.5%), ignorance of the pregnancy status (n=120; 82.5%), feed scarcity during dry season (n=120; 82.5%) and disease conditions (n=120; 97.5%) as the major reasons for the slaughter of pregnant food-producing animals in the study area (Table 5). An estimated gross income of N2.889 billion ($3,675,771), N985.5 million ($1,253,884.5), N1.277 billion ($1,624,344) and N762.660 million ($971,120.4) based on a conservative market price per average matured Cattle, Camel, Sheep and Goat respectively were lost to slaughter of pregnant food-producing animals during the seven – year study period. Additionally, 1,213,380 kg of beef, 397,485 kg of camel meat, 357,560 kg of mutton and 564368.4 kg of chevon valued at N3, 640, 140,000 ($4,610,844), N1, 192,455,000 ($1,510,443), N1, 251,460,000 ($1,609,020) and N1, 975,289,400 ($2,539,657.8) respectively, that could have accrued if the fetuses have survived and reached market value as adults were also lost.

Table 1: Prevalence of fetal wastage among different species of food-producing animals slaughtered in Maiduguri abattoir, Northeastern Nigeria (2014-2020).q

Species	Females slaughtered	Fetal wastage	Prevalence (%)	χ^2	*p-value*
Camel	36438	3458	9.5	6.560	< 0.0001
Cow	79588	10137	12.7		
Sheep	77100	13442	17.4		
Goats	94437	26760	28.3		
Total	**287563**	**53797**	**18.7**		

Table 2: Cumulative annual prevalence of fetal wastage among different species of slaughtered food-producing animals in Maiduguri, Northeastern (2014-2020).

Species	Years							Annual Prevalence (%)
	2014	2015	2016	2017	2018	2019	2020	
Goats	13.4	32.7	15.3	22.4	31.5	38.1	36.8	27.2
Sheep	15.8	21.3	18.8	26.3	19.6	13.4	13.3	18.3
Cattle	14.6	12.5	10.7	13.7	12.1	11.7	13.4	12.7
Camel	9.5	9.1	13.1	13.7	9.6	6.6	6.2	9.7

Table 3: Seasonal-prevalence of fetal wastage among different species of food-producing animals slaughtered in Maiduguri abattoir, Northeastern Nigeria (2014-2020).

Species	Season	Slaughter figure	Fetal wastage	Prevalence (%)	χ^2	*p-value*
Cow	Dry	37163	4441	12.0		
	Wet	42425	5696	13.4	5.34	0.021
Camel	Dry	15376	1389	9.0		
	Wet	21062	2069	9.8	30.08	<0.0001
Sheep	Dry	35382	6020	17.0		
	Wet	41718	7422	17.8	5.642	0.018
Goat	Dry	42689	9932	23.3		
	Wet	51748	16828	32.5	5.553	<0.0001
Total	**Dry**	**130610**	**21782**	**16.7**		
	Wet	**156953**	**32015**	**20.4**	4.458	<0.0001

Table 4: Monthly distribution of slaughtered female food – producing animals and fetal wastages documented in Maiduguri abattoir, Northeastern Nigeria (2014-2020).

Months	Camel		Cattle		Goats		Sheep	
	SF	FW	SF	FW	SF	FW	SF	FW
January	2904	266	7487	838	7465	1643	7029	1254
February	2564	130	6542	875	8819	2049	7173	1331
March	3658	470	7009	860	8272	1881	7139	1260
April	2641	331	7628	603	7935	1873	6655	1169
May	2613	204	6695	608	8160	3009	7282	1192
June	2615	300	6716	1046	7679	1886	5405	1104
July	3670	368	6010	750	7867	1744	6856	1083
August	3725	359	5936	841	6788	2371	5306	1177
September	2989	266	5069	966	6800	2678	5283	1466
October	2011	169	5286	974	6431	2603	5121	739
November	2987	383	6713	571	8023	2537	6465	861
December	3141	212	8497	1265	10198	2486	7386	1206

SF= Slaughter figure; FW= Fetal wastage

Table 5: Factors or reasons for the slaughter of pregnant food-producing animals for meat among abattoir workers (n=120) in Maiduguri abattoir, Northeastern Nigeria.

	Number (%) of respondents	
Reasons	**Yes**	**No**
1. High demand for beef, chevon, mutton or camel meat	24 (20.0)	96 (80.0)
2. Economic hardship	111 (92.5)	9 (7.5)
3. Ignorance of the pregnancy status of the animals	99 (82.5)	21 (17.5)
4. Preference of pregnant animals because of size	66 (55.0)	54 (45.0)
5. Feed scarcity during dry season	99 (82.5)	21 (17.5)
6. Disease conditions	117 (97.5)	3 (2.5)

DISCUSSION

This study revealed 287 563 of Female Food-producing Animals' Slaughter (FFAS); a high frequency and this in our opinion is the main factor for 53,797 (18.7%) fetal wastage during the study period (2014-2020). This agrees with several studies (Adama *et al*., 2011; Adeyemi *et al*., 2016; Raimi *et al*., 2017; Onyinye *et al*., 2018; Zubair *et al*., 2022) conducted in Nigeria and some African countries (Swai *et al*., 2015; Tamirat *et al*., 2015; Tasiame *et al*., 2016) that similarly reported higher rates of FFAS and fetal wastages. This negative practice has been perceived as a life-threatening factor due to its resultant effects in protein malnutrition in Nigeria and other developing countries in the world. This has a potential likelihood of constraint towards increase in livestock populations (Fayemi and Muchenje, 2013).

The high number of fetal wastages may be due to non-compliance to the rules which says only unproductive, infertile, sterile, old or accidentally injured pregnant food-producing animals are allow by law to be slaughtered. However, negative attitudinal change from the original code of conduct on public abattoir operation may be a reason behind this economic wastage due to high demand of animal protein in poor nations such as Nigeria. In addition to high cost of feeding especially in intensively manage livestock, lack of awareness of the pregnant status of the livestock, period of the study, other emergency social problems that required money. Moreover, the extensive system of rearing was predominated by nomads and is practiced without effective diagnostic tools for early pregnancy detection at the field and in the abattoir by personnel during ante-mortem inspection, absences of controlled breeding and management records in addition to abject poverty. These may cause marketing and slaughtering of pregnant female animals at high rate (Alhaji *et al*., 2015). Fayemi and

Muchenje (2013) reported that for an effective sustainable economic livestock development in West Africa food-producing animals presented at abattoirs for slaughter should be male, non-productive inactive females or an emergency or casual female slaughter. Furthermore, our questionnaire survey revealed that economic hardship (92.5%), feed scarcity during dry season (82.5%) and disease conditions (97.5%) were the major factors or reasons for the rampant slaughter of food-producing animals in the study area.

In the current study, small ruminants, Goats (27.2%), followed by Sheep (18.3%) recorded the highest average prevalence rates of fetal wastage compared to the larger ruminants. Small ruminants documented the highest slaughtered figure, which may likely explain the elevated fetal wastage; this in our opinion could be attributed to some factors such as serving as a source of immediate cash to the pastoralist's community or resource poor settings in majority of the low and middle-income countries, having a short gestation period and high fecundity. Moreover, other factors such as their ability to thrive in the arid zone as was previously reported by Monteiro *et al.* (2017) and Ndlovu *et al.* (2020) could likely explain the above findings.

The present study revealed a low frequency of fetal wastage in cattle with highest annual rate of 14.6% in 2014. Our findings were relatively lower than the 30.0% in Maiduguri reported by Iliyasu *et al*. (2015) and 17.9% reported by Zubair *et al.* (2022) in Hadeja Abattoir, Jigawa State, Nigeria. This might be attributed to the differences in the study design, period of the study and total slaughter figure recorded. However, our finding was found to be higher than that reported by Cadmus and Adesokan (2010). The observed differences could be attributed to decreased economic activities and restriction of movement due to the insurgency in the study area leading to high cost of livestock management. In 2017, Camel recorded the highest fetal wastage rate (13.7%) and this could likely correspond to the period in which high number of internally displaced persons (IDPs) migrated into Maiduguri due to the peak of the *boko haram* insurgency. Therefore, there is likely high demand of animal source proteins leading to the slaughter of high counts of Camels to supplement beef, mutton and chevon and probably may be due to its large size. The monthly distribution data for the slaughter figure and fetal wastages across the different species demonstrated some regular patterns or trends. In majority of the species, the monthly slaughter figure documented an increasing pattern during the early rainy season throughout the rainy season and late rainy seasons. This corresponds to the period with high incidences of infectious diseases and economic hardships leading the livestock farmers selling their animals to butchers. Unsurprisingly, the slaughter figures for Goats and Sheep were highest during the month of December, which corresponds with the Christian festivities (Christmas and New year). The monthly fetal wastage data across the species demonstrated similar increasing pattern among Camels and Cattle during the rainy to late rainy periods. In contrast, data from Goats and Sheep showed an irregular pattern.

The rate at which pregnant food-producing animals were slaughtered in this study signifies an unfortunate lack of pregnancy diagnosis in the abattoir or possibly a disregard for pregnant food-producing animals. Moreover, the economic losses incurred are worrisome. This agrees with Muhammad *et al.* (2007) who stated that pregnancy diagnosis is not routinely conducted during ante-mortem inspection in Nigerian abattoirs. The common reasons for these avoidable wastages were deduced to disease conditions, economic hardship, ignorance of the pregnancy status of the animal, feed scarcity during dry season, preference of pregnant animals because of their size and lastly due to the high demands for beef, chevon, mutton and camel meat in the study area. These annual trends of unselective slaughtering of pregnant livestock in various abattoirs in Nigeria with consequent fetal wastages amounting to millions of dollars will continue to persist pending implementation of policies and best ethical practices. In order to achieve such practices, there is need to employ more skilled personnel (Veterinarians and animal health workers) for ante-mortem inspection, including pregnancy diagnosis for all female food-producing animals intended for slaughter (Ugwu *et al.,* 2023). In addition, this study also emphasizes the importance of strict adherence to lay down laws/existing policy and legislation among Pastoralists, farmers, butchers and meat inspection personnel to prevent fetal wastages.

The prevalence of fetal wastage recorded in this study demonstrated that retrospective data presented an underestimated level of fetal wastage compared to a prospective study because majority of the pregnancy at first trimester was under-reported or skipped. Similarly, the current study also documented statistically significant seasonal variations in the occurrence of fetal wastages among all the slaughtered food-producing animal species. This may be attributed to the high demand of wages for farm labour, high cost of fertilizer, high seeds and crops production costs during wet season. Addition to this, other recently lactating livestocks are kept for milking by household women to carter for family daily needs. Abattoir fetal wastage (was relatively lower) during the onset of raining season (late May to June) coincides with the period of feed scarcity in the arid zone and this corroborates with the work of Iliyasu *et al.* (2015) who reported high frequency of fetal wastage in the month of June. However, the fetal wastage (was highest) during August to early November (mid-end of raining season) which tallies with the period of excessive farming stress during the rainy season and economic hardship in the study area. In agreement with this finding, Cadmus and Adesokan (2010), also reported high and low frequency of fetal wastages respectively during the rainy and dry seasons in Southwestern Nigerian slaughterhouses. In contrast to our findings, other researchers reported non-significant association between fetal wastage and seasons with high frequency of fetal wastages being recorded during early dry seasons (Ngbede *et al*., 2012; Alhaji *et al*., 2015; Raimi *et al.*, 2017; Adebowale *et al*., 2020; Zubair *et al*., 2022). The observed significant disparity may be attributed to the high frequency of food-producing animals presented for slaughter within the study period and thus even minor existing differences could be detected.

Conclusion

In conclusion, about one in every five (18.7%) female food-producing animals slaughtered in Maiduguri abattoir was

pregnant leading to loss of 53 797 fetuses, with specie-specific prevalences of 28.3%, 17.4%, 12.7% and 9.5% for Goat, Sheep, Cow and Camel respectively. About ₦2.889 billion ($3,675,771), ₦985.5 million ($1,253,884.5), ₦1.277 billion ($1,624,344) and ₦762.660 million ($971,120.4) would have been earned if the fetuses were protected and raised to maturity. Furthermore, 1,213,380 kg of beef, 397,485 kg of camel meat, 357,560 kg of mutton and 564368.4 kg of chevon valued at ₦3, 640, 140,000 ($4,610,844), ₦1, 192,455,000 ($1,510,443), ₦1, 251,460,000 ($1,609,020) and ₦1, 975,289,400 ($2,539,657.8) respectively, were also lost. Species and seasonality strongly affect the occurrence of fetal wastage with greater magnitude observed during the wet months of August – October. Disease conditions, economic hardships and feed scarcity during dry season were the major reasons for the slaughter of pregnant food-producing animals.

Acknowledgement

We will like to thank Maiduguri abattoir workers and most especially administrative office for their support during data collection.

Conflict of Interest

The authors do not have any conflict of interest to declare.

Authors' Contribution

SMJ and SM contributed to the study concept and design. Material preparation, data collection and analyses were performed by DJ and ETE. The draft of the manuscript was prepared by SMJ, SM and DJ. SMJ, SM and DJ read, corrected and approved the manuscript for publication. All authors have read and approved the final manuscript.

REFERENCE

Adama, J. Y., Shiawoya, E. L. and Michael, N. (2011). Incidence of foetal wastages of cows slaughtered in Minna abattoir, Niger state, Nigeria. J. Appl. Biosci., 42: 2876-2881 http://repository.futminna.edu.ng:8080/jspui/handle/123456789/765

Adebowale, O. O., Ekundayo, O. and Awoseyi, A. A. (2020). Female cattle slaughter and fetal wastage: A case study of the Lafenwa abattoir, Ogun state, Nigeria. Cogent Foo. Agric., 6:1. 1809308, DOI: https://doi.org/10.1080/23311932.2020.1809308

Adeyemi, A. B., Adamu, M., Dawuda, P. M. and Oyedipe, E. O. (2016). The economic implications of fetal wastage in cattle, sheep and goats in Makurdi abattoir, Benue State, Nigeria. Nigerian Vet. J., 37(4): 198–205

Alhaji, N. B., Odetokun, I. A., Shittu, A., Onyango, J., Chafe, U. M., Abubakar, M. S., Muraina, I. A., Fasina, F. O. and Lee, H. S. (2015). Time-series analysis of ruminant fetal wastage at a slaughterhouse in North Central Nigeria between 2001 and 2012. Onderstepoort J. Vet. Res., 82(1): 1–13 PMID: 26842363 DOI: 10.4102/ojvr.v82i1.1010

Cadmus, S. I. B. and Adesokan, H. K. (2010). Bovine fetal wastage in Southwestern Nigeria: A survey of some abattoirs. Trop. Ani. Healt. Prod., 42(4): 617–621 DOI: 10.1007/s11250-009-9465-x

Casey, N. H., Niekerk, W. A. and Webb, E. C. (2003). Goat meat, (Caballero B, Ed.) Encyclopedia of Food Sciences and Nutrition, 2nd Ed, Academic Press, Pp. 2937-44.

Chama, T. H., Matthew, D. A., Chama, J. H. and Bala, D. B. (2019). Economic implications of small ruminant fetal wastage: a case study of Jalingo abattoir, Taraba State. Sokoto J. Vet. Sci., 17(2): 73-76 DOI: 10.4314/sokjvs.v17i2.11

Craig, P. S. (1982). The Management of a small Holder cattle fattening credit scheme in Nigeria. Nigeria: Proceedings of National Beef Conference, Kaduna. 350-398.

Fayemi, P. O. and Muchenje, V. (2013). Maternal slaughter at abattoirs: History, causes, cases and the meat industry. Springerplus, 2(1): 125–131 PMID: 23577300 DOI: 10.1186/2193-1801-2-125

Food and Agriculture Organization (2013). Current worldwide annual meat consumption per capita, Livestock and Fish Primary Equivalent. Available online: http://www.fao.org/faostat/en/#data/CL (Accessed on 10/07/2023)

Food and Agriculture Organization (FAO) (2014). Stocks of cattle, sheep and goats for Nigeria. FAOSTAT. Available online: https://www.fao.org/faostat/en/#home (Accessed on 10/07/2023)

Iliyasu, D., Ogwu, D, Yelwa, H., Yaroro, I., Ajani, J. A., Auwal, U., Bugau, J, S., Kuzayed, I. G. and Jibrin, U. R. (2015). Incidence of Bovine Pregnancy Wastage in Maiduguri Abattoir, Borno State Nigeria. Int. J. Livest. Res., 5(8): 59-65

Mahgoub, O. and Lodge, G. A. (1998). A comparative study on growth, body composition and carcass tissue distribution in Omani sheep and goats. The J. Agricult. Sci. (Cambridge), 131 (3): 329-339 DOI: https://doi.org/10.1017/S0021859698005887

Monteiro, A., Costa, J. M. and Lima, M. J. (2017). Goat system productions: Advantages and Disadvantages to the animal, environment and farmer. In: Kukovics S, Editor, Goat Science, IntechOpen, London Available online: https://www.intechopen.com/chapters/56453 (Accessed on: 10/07/2023)

Muhammad, I. R., Ashiru, R. and Abdullahi, A. Y. (2007). Implications of the slaughter of pregnant ewes and does to future stock in the semi-arid urban abattoir. J. Ani. Vet. Adv., 6(6): 819–822 https://medwelljournals.com/abstract/?doi=javaa.2007.819.822

Müller, O. (2005). Malnutrition and health in developing countries. The Canadian Medica. Asso. J., 173(3): 279–286 PMID: 16076825 DOI: 10.1503/cmaj.050342

National Population Commission (NPC) (2006). Population Census Data, Borno State, Nigeria. Federal Republic of Nigeria Official Gazette, National and State Provisional Total Census. Lagos, Nigeria, 94 (21): 175-198.

Ndi, C., Tambi, N. E. and Agharih, N. W. (1993). Reducing calf wastage from the slaughtering of pregnant cows in Cameroon. Available online: https://www.fao.org/3/v1650t/v1650t0g.htm (Accessed on 10/07/2023)

Ndlovu, C., Mayimele, R., Wutete, O. and Ndudzo, A. (2020). Breeding of goats: An indigenous approach

to enhancing opportunities for smallholder farmers in Inyathi, Zimbabwe. Int. J. Livest. Prod., 11(3): 91-101 DOI: https://doi.org/10.5897/IJLP2019.0586

Ngbede, E. O., Hena, S. A., Oguntoye, O. O., Tarhyel, R. and Bulus, C. (2012). Bovine fetal wastage and its economic implication: a six-year (2003 – 2008) retrospective study in an abattoir in Northwestern, Nigeria. Scient. J. Vet. Adv., 1(2): 42–46

Njoga, E. O., Njoga, U. J., Abonyi, F. O., Edeh, H. O., Ajibo, F. E. and Azor, N. (2021). Bovine fetal wastages in Nsuka Nigeria: prevalence, causes and public health implications. Vet. Italiana, 57(2): 105-109 DOI: 10.12834/VetIt.2225.12292.1

Nma, B. A. (2011). Prevalence and economic implications of calf fetal wastage in an abattoir in North Central Nigeria. Trop. Ani. Healt. Prod., 43(3): 587–590 DOI: 10.1007/s11250-010-9735-7

Nonga, H. E. (2015). A review on cattle fetal wastage during slaughter and its impacts to the future cattle herds in Tanzania. Livest. Res. Rural Dev., 27(12) Available online: http://www.lrrd.org/lrrd27/12/nong27251.html (Accessed on 10/07/2023)

Onyinye, J., Okorie-Kanu, O. J., Ezenduka, E. V., Okorie-Kanu, C. O., Anyaoha, C. O., Attah, C. A., Ejiofor, T. E. and Onwumere-Idolor, S. O. (2018). Slaughter of pregnant goats for meat at Nsukka slaughterhouse and its economic implications: A public health concern. Vet. Worl., 11(8): 1139–1144 PMID: 30250375 DOI: 10.14202/vetworld.2018.1139-1144

PennState Extension (2021). Understanding beef carcass yields and losses during processing. Available online: https://extension.psu.edu/understanding-beef-carcass-yields-and-losses-during-processing (Accessed on 21/08/2022)

Raimi, C. O., Oduguwa, B. O. and Bamgboye, F. O. (2017). Slaughtered Cattle and Reasons for slaughtering cows in ember months at Lafenwa abattoir in Abeokuta, Nigeria. European J. Agric. Forest Res., 5(1): 1–8 DOI: https://doi.org/10.37745/ejafr.2013

Salehi, M. Mirhadi, S. A., Ghafouri-Kesbi, F., Fozi, M. A. and Babak, A. (2013). An evaluation of live weight, carcass and hide characteristics in Dromedary vs BactrianxDromedary crossbred camels. J. Agricult. Sci. Tech., 15: 1121-1131 URL: https://jast.modares.ac.ir/article-23-4911-en.pdf

Schonfeldt, H. C. and Hall, N. G. (2012). Dietary protein quality and malnutrition in Africa. British J. Nutrit., 108(S2): 69-76 DOI: 10.1017/S000711451200255 3

Swai, E. S., Ayubu, H. and Mhina, B. S. (2015). Incidence of fetal wastage in sheep and goats slaughtered at Tanga city abattoir, Tanga, Tanzania. Livest. Res. Rural Dev., 27(10). Available online: http://www.lrrd.org/lrrd27/10/swai27213.html (Accessed on 10/12/2022)

Tamirat, C., Wakayo, B. U., Mohammed, O. and Dewo, T. F. (2015). Small ruminant fetal wastage at Asella Abattoir in Central Ethiopia; Reflection on potential country level implications. Int. J. Livest. Res., 5(11): 55–61.

Tasiame, W., Emikpe, B., Folitse, R. D., Fofie, C. O., Johnson, S., Burimuah, V., Atawalna, J., Boateng, E. and Amemor, E. (2016). Foetal wastage in sheep and goats at the Kumasi Abattoir in Ghana: A Cross-Sectional Study. Arch. Bas. App. Med., 4(2016): 125 – 128

Taiwo, B. B. A., Aluko, F. A. and Olufowobi, O. A. (2006). Reproductive wastage in some urban abattoirs in Ogun State. In: Muhammad, I.R., Muhammad, B.F., Bibi- Farouk, F., Shehu, (Eds.), Application of appropriate technology in overcoming environmental barriers in animal agriculture in Nigeria. Proceedings of the 31st Annual Conference of The Nigerian Society of Animal Production, Pp: 140–142.

Ugwu, P. C., Njoga, E. O., Njoga, U. J., Aronu, C. J., Atadiose, E. O., Okoli, C. E., Onwumere-Idolor, O. S., Ajibo, F. E., Azor, N. N., Bernard, S. N., Ozioko, I. E., Eze, I. S. and Abonyi, F. O. (2023). Indiscriminate slaughter of pregnant goats for meat in Enugu, Nigeria: Cause, prevalence, implications and ways-out. PLoS One, 18(1): e0280524. PMID: 36649264 DOI: 10.1371/journal.pone.0280524

Worldometer (2022). Nigeria population. Available online: https://www.worldometers.info/world-population/nigeria-population/ (Accessed on 24/08/2022)

Zubair A. H., Haruna, U., Iliyasu, D., Mustapha, A.R., Lawan, A. F., Mustapha, M. Adamu, L. and Muhammad, S. T. (2022). Retrospective Study of Cattle Fetal Wastage at Hadeja Abattoir, Jigawa State: Economic Implication and Seasonal Variation. Sahel J. Vet. Sci., 19(1): 31 – 34 DOI: https://doi.org/10.54058/saheljvs.v19i1.303