Female cattle slaughter and foetal wastage: A case study of the Lafenwa abattoir, Ogun state, Nigeria

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Abstract: In developing countries, indiscriminate slaughtering of pregnant ruminants and consequent foetal wastage (FW) are persistent practices, which have impacted the agricultural and economic advancement of such countries. Retrospective data from 2008 to 2016 of a municipal slaughterhouse in Ogun state, Nigeria was assessed for the current patterns of female cattle (FC) slaughter and FW. A total of 353,503 (mean/year: 29,457 ± 1651) FC were slaughtered, and 44,713 (12.65%; mean/year: 3,726 ± 584) FW estimated over a period of 9 years. There were significant yearly variations in throughput of FC and FW ($p < 0.0001$), and a strong and positive correlation between FC and FW ($r = 0.74$, $p = 0.006$). We report a significant increase in FC slaughter and FW. Action plans such as awareness programs among livestock stakeholders, review on slaughter reforms, enforcement of policies that encourage realistic and positive attitude geared towards sustainable livestock practices, animal welfare, food security, and prohibition of pregnant animal slaughtering are required.

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PUBLIC INTEREST STATEMENT

The livestock industry in Nigeria has grown to about 19.5 million cattle, 115 million sheep and goat, and 160 million poultry according to the national agriculture resource survey, 2016. However, the country still struggles to meet the growing demand of an increasing population to animal meat proteins, while ending hunger, achieving food security, improving nutrition and sustainable agriculture by the year 2030 through the UN SDG 2 strategic objectives appearing unattainable. Our study provided information on a nine-year retrospective record of foetal wastage and female animal slaughter in a major abattoir in Nigeria and report the persistence of these practices. Foetal wastages significantly impact herd size negatively, and careful planning and formulation of policies through appropriate evidence-based approach are needed in livestock production management. Developing educational intervention strategies for livestock industry stakeholders and mechanisms to facilitate early detection of pregnant animals and the establishment of appropriate standards of best practices are required.
1. Introduction
Nigeria is endowed with ruminant livestock resources, e.g., cattle, sheep, and goat, which are estimated at 19.2 million, 38.5 million and 57.4 million, by Food and Agriculture Organization [FAO] (2014), respectively. The livestock annual growth rates are low to satisfy the requirements of the ever-increasing human population of over 170 million (Alhaji et al., 2015). Although the amount of livestock production in Nigeria and other developing countries has marginally increased on average, persistent malnutrition and low intake of good quality animal protein (individual protein dietary intake is less than 9 kg, well below the United Nation’s Food and Agricultural Organization—FAO (2013) recommendation of 41.9 kg/person) continues to be a significant public health threat especially in children (Müller, 2005; Schonfeldt & Hall, 2012). Malnutrition has been associated with a high prevalence of more than 80% infectious diseases (e.g., malaria, tuberculosis, measles, and HIV/AIDS), over 300,000 deaths, and about half of all mortalities in young African children (Müller, 2005).

Agricultural sustainability strategy such as mitigation of slaughtering of pregnant food animals in many developing countries needs to be addressed as a priority to increase the availability of quality animal protein. Although slaughtering of pregnant food animals and the fate of unborn foetuses are relatively new in the field of animal welfare, it has, however, gained importance in public debates globally (Maurer et al., 2016). Foetal wastage has primarily been related to substantial economic losses; scientific reports that foetuses can feel stress and pain from the second half of the gestation on (Bellieni & Buoncore, 2012; Maurer et al., 2016; More et al., 2017), and that globally, large numbers of abattoirs still slaughter pregnant animals. The magnitude of the slaughter of pregnant animals and consequent embryo losses has also been reported in Europe countries (More et al., 2017). The prevalence is, however, higher in African countries ranging from 1.3% to 45% (Nonga, 2015). In Nigeria, the magnitude of pregnant female cattle slaughter and the foetal wastage has been reported by several authors (Addass et al., 2010; Alhaji, 2011; Alhaji et al., 2015; Awoyomi et al., 2013; Cadmus & Adesokan, 2010; Ngbede et al., 2017; Nwakpu & Osakwe, 2007; Ogunbode & Oladele, 2016; Raimi et al., 2017). Also, the associated economic losses have been estimated close to US$290 000 (Ngbede et al., 2017) and US$18,442,883.52 (Awoyomi et al., 2013).

To date, FW in Nigerian abattoirs is yet to be addressed by the industry stakeholders. Policies to ensure animal welfare, the prohibition of slaughtering of pregnant animals and protection of unborn foetuses are yet not given cognisant considerations. Only one study in central Northern Nigeria provided detailed information on the seasonal trend analysis of ruminant foetal wastage (Alhaji et al., 2015). The data provided in this present study would assist to develop a guide to future policy formation and strategic action plans for ensuring high animal welfare standards, protection of unborn animal foetuses and sustainable livestock practices.

2. Materials and methods
2.1. Study location
The municipal slaughterhouse (SH) investigated is located in Abeokuta North local government area (latitude 3°19.665’E and longitude 7°09.775’N and has an area of 16,400 KM²), Ogun State, Nigeria. Abeokuta’s population is currently estimated at 532,856. Ogun borders Lagos State to the south, Oyo and Osun states to the north, Ondo to the east and the Republic of Benin to the west. Abeokuta is the capital and largest city in the state. The state’s appellation is “Gateway to Nigeria”, and was created in February 1976 from the former Western State. The 2006 National population census estimated the human population at 3,751,140.
2.2. The slaughterhouse layout

The slaughterhouse (SH) was an enclosed premise, which consisted of necessary facilities such as a lairage, meat markets, administrative block, veterinary officer post, slaughter slabs. Hygiene amenities, e.g., cooling room, hand washing, changing rooms and toilets, cleaning and disinfection of the abattoir premise, and animal waste management were inadequate or non-functional. Solid and liquid wastes were disposed of within and around receiving surface water banks, which also served as the source of water for meat processing.

The lairage, situated about 500 m North East (Lat: 7° 10’ 02.30” and Long: 003° 19’ 36.79”) of the SH, received and rested trade cattle—at least 24 hours before slaughter. The SH at its full operations processes at least a total number of 150–200 heads of cattle daily, and supplies meat to the public within and around Abeokuta environs (Adebowale et al., 2016). Antemortem inspection and treatment of sick animals were performed within the lairage by veterinary officers in line with the Nigerian meat edict of 1978 to ensure animal health status before slaughter. The lairage led to two slaughter slabs—enclosed and open slaughter slabs, where floor processing and mixed operations (clean and dirty) were still common practices. Herein, post-mortem meat inspections were carried out by qualified veterinarians and para-veterinarians. The routine inspection protocol employed included visual inspection, palpation, and incision of visceral organs. Afflicted organs were routinely condemned partially or totally based on the extent of infection and veterinary personnel’s judgment.

Veterinary officers were present at SH from 7 a.m. (commencement of animal slaughtering) to 11 a.m. (end time for slaughtering) from Mondays to Saturdays. Available data showed a decrease in total of the animal slaughtered yearly. For instance, there was 11.8% decrease in throughput of animals killed in 2016 compared to 2014 of which the economic recession and high costs of livestock production in the country may have contributed to this. There were eight veterinarians fully assigned for meat inspection at the SH. The veterinarian to animals slaughtered ration 1:10. Bovine is the only livestock specie killed in the SH.

3. Data source and collection

Our study at this moment investigated the current patterns and seasonal associations of foetal wastages at a municipal slaughterhouse in Ogun State, Nigeria. The study involved the following: 1) Visits and inspections the facility; 2) Collection of the 9-year historical data (2008–2016), and 3) Analysis of patterns of FC slaughter and FW. For this study, a retrospective slaughterhouse (SH) study design was employed. Secondary data on the number of female cattle animals’ (FC) slaughtered and foetal wastage (FW) from 2008 to 2016 were obtained from abattoir records provided by the Veterinary Department services, Ogun State Ministry of Agriculture. The data were considered suitable based on records of various parameters (FC slaughtered and FW) under investigation presented by the veterinary department. To better understand the pattern in FW about seasons, the months were divided into early dry, early rainy, late rainy, and late dry, according to Alhaji et al. (2015). Seasons were defined as groups of months, with a) Late dry: January to March, b) Early rain: April to June, c) Late rain: July to September, and d) Early dry: October to December.

Information on the number of pregnant animals slaughtered during this period was not available from the abattoir records provided by the department of veterinary services. Researchers visited the abattoir facility and noted its location, layout, facilities, and processes.

4. Data analysis

Data were entered into Excel spreadsheet (2016) and exported into computer statistical analysis software GraphPad Prism 8.0 for further analysis. For the descriptive statistics, the total number of female cattle animals (FC) slaughtered and foetal wastage (FW) from 2008 to 2016 were computed. The annual, monthly, and seasonal frequencies of both variables (FC slaughtered and FW) were estimated. Descriptive rates of distribution were presented as line graph plots with the
standard error of the mean to demonstrate the data variability. One-way ANOVA or Kruskal–Wallis tests were used to compare the mean variations in numbers of FC slaughtered and FW annually, monthly and seasonally. For further comparisons, Dunnett’s multiple tests were performed using the year 2008 and month January as references due to their lowest record rates of FW. Differences were considered statistically significant at P < 0.05.

Prior all analyses normality tests of datasets were carried out using Shapiro–Wilk test and Kolmogorov–Smirnov test (p >0.5). Where datasets violate the assumption of normality, a non-parametric Kruskal–Wallis test was used.

5. Results

5.1. Female cattle animal slaughter data
From available data (2014 – 2016), female cattle animals (FC) are five times more likely to be slaughtered than male animals. The number of male animals slaughtered drastically reduced from 2014 to 2016 compared to female ones. For instance, there were 44.1% and 46.3% reduction in male animals killed in 2015 and 2016 compared to 2014. Unlike FC, where there was only 1.5% decrease in numbers slaughtered in 2016 and a 12.6% increase of slaughter in 2015 compared with the year 2014. Between 2008 and 2016, a total number of 353,503 (mean 29,457 ± 1651 per year) FC was slaughtered. The highest throughput of slaughter was observed in the year 2015 (44,321; mean 3,693 ± 275) and the month December (31,970; mean 3,552 ± 464; See Tables 1 and 2). There was a statistically significant variation in the yearly slaughter of animals (p < 0.0001). Figure 1(a and b) show the annual and monthly distributions of FC slaughtered during this study period. The seasonal pattern of slaughtering showed FC were most killed during the early dry (93,173; mean 10,353 ± 1165), and lowest during the late dry seasons (84,265, mean 9363 ± 2056). However, no seasonal effect was observed (p = 0.28). Figure 1(c) presents the seasonal pattern in FC slaughtered.

6. Foetal wastage data
Between 2008 and 2016, the total number of foetal wastage (FW) estimated was 44,713 (mean 3726 ± 584 per year). The prevalence of FW was estimated at 12.6% based on the total number of female animals slaughtered during the period of investigation. For every eight FC slaughtered, one foetal wastage was reported. The highest throughput of FW was observed for 2016 (5,699, mean 475 ± 67) and the month August (4,398, mean 489 ± 61; Tables 1 and 2). There was a statistically significant variation in yearly (p < 0.0001) and monthly wastage (p = 0.0007). FW was significantly higher in August (p = 0.02) and October (p = 0.03). An upward trend in FW across the years was

| Year | Female cattle animals slaughtered | Foetal Wastage |
|------|----------------------------------|----------------|
|      | Total no | Mean ± SD | 95% CI of mean | Total no | Mean ± SD | 95% CI of mean |
| 2008 | 28,761    | 2397 ± 633 | 1995-2799      | 3236    | 270 ± 121 | 193-346       |
| 2009 | 36,571    | 3048 ± 340 | 2831-3264      | 5420    | 452 ± 57  | 416-488       |
| 2010 | 40,312    | 3359 ± 291 | 3174-3544      | 5537    | 461 ± 34  | 440-483       |
| 2011 | 42,836    | 3570 ± 256 | 3407-3732      | 4799    | 360 ± 50  | 368-432       |
| 2012 | 41,567    | 3464 ± 364 | 3232-3695      | 4233    | 353 ± 54  | 318-387       |
| 2013 | 40,996    | 3416 ± 209 | 3284-3549      | 5120    | 427 ± 115 | 354-500       |
| 2014 | 39,368    | 3281 ± 286 | 3099-3463      | 5071    | 423 ± 47  | 393-453       |
| 2015 | 44,321    | 3693 ± 275 | 3519-3868      | 5598    | 467 ± 40  | 441-492       |
| 2016 | 38,771    | 3231 ± 490 | 2920-3542      | 5699    | 475 ± 67  | 432-518       |
| TOTAL| 353,503   | 39,278 ± 4549 | 6,458-42,098 | 44,713   | 4968 ± 795 | 4475-5461     |
Table 2. Summary of monthly number of female cattle (FC) slaughtered and foetal wastage (FW) at the Lafenwa municipal slaughterhouse in Abeokuta, Nigeria from 2008–2016

| Month  | Total no | Mean ± SD | 95% CI of mean | Total no | Mean ± SD | 95% CI of mean |
|--------|----------|-----------|----------------|----------|-----------|----------------|
| January | 27,722   | 3080 ± 3080 | 2455–3705        | 3209     | 357 ± 104 | 276–437        |
| February | 27,182   | 3020 ± 3020 | 2488–3552        | 3274     | 364 ± 108 | 281–447        |
| March   | 29,361   | 3262 ± 3262 | 2803–3722        | 3234     | 360 ± 96  | 287–434        |
| April   | 27,667   | 3074 ± 3074 | 2806–3342        | 3234     | 359 ± 73  | 303–416        |
| May     | 28,854   | 3206 ± 3206 | 2904–3508        | 3543     | 394 ± 85  | 329–459        |
| June    | 27,846   | 3094 ± 3094 | 2732–3456        | 3670     | 408 ± 95  | 335–481        |
| July    | 30,269   | 3363 ± 3363 | 3056–3670        | 3872     | 430 ± 111 | 345–515        |
| August  | 31,850   | 3539 ± 3539 | 3329–3749        | 4398     | 489 ± 61  | 442–536        |
| September | 29,579   | 3287 ± 3287 | 2988–3585        | 4215     | 468 ± 62  | 421–516        |
| October | 30,999   | 3444 ± 3444 | 3115–3773        | 4311     | 479 ± 50  | 440–518        |
| November | 30,204   | 3356 ± 3356 | 2984–3728        | 4069     | 450 ± 77  | 391–509        |
| December | 31,970   | 3552 ± 3552 | 3196–3909        | 3695     | 411 ± 66  | 360–461        |

Figure 1. Female cattle (FC) slaughtered for the period 2008–2016 at the slaughterhouse in Abeokuta, Ogun state, Nigeria. (a)Yearly, (b) monthly, and (c) Seasonal pattern of FC slaughter in Nigeria.

observed except in 2011 and 2012. Figure 2(a and b) are the yearly, and monthly distributions of FW investigated in this study. The seasonal pattern of FW was highest during the late rains (12,485, mean 462 ± 82) and lowest in the late dry (9,587; mean 360 ± 99). A seasonal effect was observed with p = <0.0001. The scatter plot showed a strong, positive, statistically significant monthly correlation between FC slaughtered and FW (r = 0.74; 95% CI = 0.28 to 0.92; p = 0.006). Figure 2(c) shows the seasonal pattern of FW and Figure 2(d) presents the relationship pattern between FC and FW.

7. Economic implication of foetal wastage
The economic implication of the foetal wastage was estimated for the total number of foetal wastage by the amount worth in Naira (₦) if foetuses were allowed to grow into adults. An adult cattle of about 250 kg costs ₦ 230,000. So, for a period of 9 years, a total of ₦1,142,640,000 ($2,943,886.22) and ₦94,530,000 ($234,546.14) annually are lost. The current exchange rate is 1 USD to ₦388.14
8. Discussion

8.1. Pattern of female cattle slaughtering

This study was conducted to determine the pattern of female cattle (FC) slaughter and foetal wastage practice in a slaughterhouse (SH) in Southwestern Nigeria. Our findings revealed that the ratio of female to male animals slaughtered in the SH was 5:1, i.e., female cattle animals are five times more likely to be slaughtered than male. Several studies within Nigeria (Adama et al., 2011; Adeyemi et al., 2016; Hassan et al., 2016; Onyinye et al., 2018; Raimi et al., 2017) and in other African countries (Swai et al., 2015; Tamirat et al., 2015; Tasiame et al., 2016) have reported higher rates of female livestock animals slaughter. Nevertheless, other authors have documented otherwise (Bello et al., 2012; Uduak & Samuel, 2014; Alhaji et al., 2015; Ogunbodede & Oladele, 2016; Baba et al., 2018). The heterogeneous data on the female animal slaughter in the different studies can be attributed to firstly, variations in study designs, especially investigation periods. Secondly, the production management system types, i.e., whether intensive or highly extensive, may be factors for high rates of female animals and subsequent pregnant ones presented for slaughter. Female animals raised in an intensive management system, especially for milking, breeding, or meat production are less likely to be sent for slaughter except where there are health or reproductive issues. However, in many developing countries, including Nigeria where extensive rearing systems are practiced with no controlled breeding, no records and diagnostic tools for early pregnancy detection, selling of female animals and pregnant ones for slaughtering are usually high (Alhaji et al., 2015; Hassan et al., 2016). On-farm diagnostic facilities for early detection of pregnant animals are absent, and routine pregnancy diagnoses may not be performed or documented as most cattle rearers in Nigeria are nomads or pastoralists with little or no education. To promote, sound economic livestock management and sustainability in developing countries, animals presented at abattoirs for slaughter should be males, and reproductively inactive females (Fayemi & Muchenje, 2013). Also, cattle farmers, especially the nomads, can be educated on and provided with user-friendly rapid test kits at subsidised rates by the government to ascertain pregnancy status of female animals before selling off to the abattoirs. The slaughtering of high rates of female animals which are maybe a key predictor for foetal wastage has consequent impacts on livestock industry productivity, sustainability (as more females are required in reproductive and milk production processes than males), and food security in Nigeria. This practice has been observed as a critical factor for protein malnutrition in African countries and a possible constraint to future livestock populations on the continent (Fayemi & Muchenje, 2013)
The total throughput of FC slaughtered reported in this study during 9 years was 353,503 (mean 29,457 ± 1,651). Comparing our data with a previous study conducted by Cadmus and Adesokan (2010), there was a decreased pattern in the number of FC slaughtered at the slaughterhouse. The decrease may be attributed to the current economic crisis faced by the country, which has resulted in high livestock management and production costs. We observed FC slaughter peaked in 2015 and especially in December (characterised by high sales due to Christmas festivities and ceremonies) but declined again by 12.5% in 2016. Although there was no seasonal effect on the FC slaughtered, the annual trend indicated FC slaughter occurred most times during the early dry, i.e. October–December (93 173; mean 10,353 ± 1165). The outcome is not surprising as other authors have reported similar pattern at different abattoirs in past studies (Cadmus & Adesokan, 2010; Ngade et al., 2012; Alhaji et al., 2015; Hassan et al., 2016; Raimi et al., 2017). Sales and butchering of female animals and consequent slaughtering of pregnant females becomes higher at the late rains and as the dry season progresses because, during drought season, sparse feed supply, dangers of poor nourishment, loss of body conditions, diseases and death become intense mainly due to trypanosomosis. A reduction in slaughtering during the late dry (January—March) compared with other seasons was observed similar to what was described by Cadmus and Adesokan (2010) for the slaughterhouse. However, this was contrary to what we anticipated, as explained previously. One explanation for this is that more cows are disposed to mating and conceiving during rainy seasons because of feed lush, which results in calving during the next early rainy season when there is abundant food for them and their offspring (Ngade et al., 2017). Pregnancies at the late stage may then be evident to farmers, who would prefer to keep the heifers to calve, and nourish their young ones during the next early rains, and also to generate more profits.

9. Foetal wastage patterns
The data revealed that 12.6% of foetuses were wasted based on the total number of female animals slaughtered in the period between 2008 and 2016. This outcome is similar to a few previous studies that were conducted in the year 2013 at the same slaughterhouse investigated. Oduguwa et al. (2013) and Awoyami et al. (2013) reported a 10.7% and 10.3% foetal wastage within a three-month retrospective and one-year prospective surveys, respectively. A similar outcome was observed in an abattoir in Ebonyi, and Yola states, Nigeria (9.2%, Nwokpu & Osakwe, 2007 and 14.4%; Ardo et al., 2013), Kumasi, Ghana (18.4%, Atawalna et al., 2013), Bukoba Municipal abattoir, Tanzania (15.6%, Nonga, 2015). Furthermore, the prevalence of FW from our study was twice those reported by Cadmus and Adesokan (2010) at 6% for the same SH. The length of study (2005–2007), lapses and poor practices in record keeping due to inability to identify cases of foetal loss may have contributed (Cadmus & Adesokan, 2010) to this discrepancy. Also, the population of slaughtered cattle may have increased from the time of the study (Cadmus & Adesokan, 2010) to 2018. Lower rates of FW compared to what our data indicated have also been documented by other authors from different locations in Nigeria. Data as low as 2.4% (Benue; Adeyemi et al., 2016); 3.9% (Benue; Abdulkadir et al., 2008); 3.8% (Minna; Adama et al., 2011); 4.5% (Minna; Alhaji et al., 2015); 4.5% (Jos; Dunka et al., 2017) were recorded. Meanwhile, higher percentages of foetal wastage have been described for abattoirs in other parts of the country—Hassan et al. (2016) (40.7%; Lafia); Ogbonode and Oladele (2016) (35.7%; Ibadan) Akpabio and Babalola (2014) (22.4%; Abak). Another study conducted by Mutwedu et al. (2019) in the Democratic Republic of Congo recorded a fetal recovery rate of 26.3% (over twice observed in our study). The diverse data on foetal wastage in different parts of the country may be explained similarly as previously described for FC. Firstly, variations in study designs and investigation periods. Secondly, the production management system type, highly extensive may be factors for high rates of pregnant animals presented for slaughter and subsequent foetal loss. Thirdly, best practices and standards in record keeping may have varied from one abattoir to another, which may have introduced bias in the observed trends and seasonality. Fourthly, studies of mating and conception patterns have not been linked to pregnancy age and seasonal as well as migratory patterns of herders, as transit can take months on the
hooves, from the north of the country to the south, with pockets of lush vegetation increasing conception along the way.

Our analytic study investigated foetal wastage across seasons. The data indicate that female cattle animal (FC) slaughter was highest during the early dry, while foetal wastage (FW) was significantly elevated during the late rains ($p < 0.0001$) and early dry ($p = 0.0008$) compared with the late rains when there was the least wastage. This observation was slightly varied from what has been reported by previous studies which concluded that foetal losses amongst cattle occur more often in the dry seasons in slaughterhouses and abattoirs across Nigeria (Cadmus & Adesokan, 2010; Ngbede et al., 2017; Nwakpu & Osakwe, 2007).

The seasonal component of study by Alhaji et al. (2015) reported a single peak (≤7%) per year, with the highest foetal wastage rates observed from the middle to later months of the year (May–October, i.e. early rains through the early dry). Another study, which was a year incidence report by Awoyomi et al. (2013), did not report any seasonal association with FW. This period may be too short to detect any seasonal change in the incidence of foetal wastage. We should also bear in mind that many factors may come to play in the differences in seasonality’s in FC slaughtered and FW reported. Seasonal drifts may be affected by various circumstances such as record-keeping practices, occasions, and festivities, economic status and improved living standards, as well as uncertainties and risks such as drought, diseases and animal movements by pastoralists for greener pastures (Alhaji et al., 2015). Another logical reason, especially for more FW at early dry and late rains, may be correlated to high numbers of female animals and subsequent slaughtering of pregnant ones during this period.

The economic losses associated with indiscriminate slaughtering of pregnant animals in abattoirs in Nigeria have been quantify and reported to be huge (running into millions of dollars annually) and findings from this study support other previous findings in the country and other African countries (Alhaji & Odetokun, 2013; Awoyomi et al., 2013; Bokko, 2011; Nma, 2011; Nonga, 2015; Tamirat et al., 2015). The cyclic trends and patterns of pregnant animal slaughtering and subsequent foetal wastage will continue until improvements in legislation/policies and best standard practices for abattoirs concerning meat inspections and animal welfare are enhanced in the country. This study further underscores the need to enforce legislation and policy currently existing, to prevent foetal wastage and ensure adherence by farmers. Also, the need to improve on antemortem diagnostic skills and facilities for early detection of pregnant animals, especially at first trimesters is essential. Further, estimation of meat protein loss and economic impact of FW, i.e. monetary, should be comprehensively examined.

10. Conclusions and recommendations
The study indicated indiscriminate slaughter of FC persists as a widespread practice in abattoirs in Nigeria. This practice may impact the productivity and sustainability of livestock and by implication, the livestock industry in the country. Further, inadequacies in routine antemortem facilities and veterinary inspection of animals, which are crucial for early detection and mitigation of pregnant animals slaughtering are highlighted. Also, this study indicates that data and surveillance systems for tracking FC slaughter and FW to help develop effective mitigation plans to prevent pregnant FC slaughter and FW in the country are inadequate. To meet the country’s animal protein demand by the ever-increasing human populations, there is an urgent need for educational intervention to create awareness for livestock farmers and industry stakeholders on the extent of the problem especially the economic and public health consequences. Animal welfare policies and strategies that prohibit indiscriminate pregnant animals slaughter, enforced and implemented with incentives or penalties, are urgently needed. Mechanisms to facilitate the early detection of pregnant animals (including adequate training, establishment and implementation of appropriate standards of best practices) and prevent inappropriate slaughtering are also needed.
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Conflicts of interest
The authors disclose there are no financial and personal relationships with other people or organizations that may compromise or inappropriately influence or bias in this study.

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References
Abdulkadir, U., Jiya, E. Z., & Kosu, S. A. (2008). Survey of foetal wastages: A case study of Makurdi abattoir in Benue State from 1997 to 2002. Pakistan Journal of Nutrition, 7(3), 450–452. https://doi.org/10.3923/pjn.2008.450.452
Adama, J. Y., Shiwoya, E. L., & Michael, N. (2011). Incidence of foetal wastages of cows slaughtered in Minna abattoir, Niger state. Nigeria. Journal of Applied Biosciences, 42, 2876–2881. www.biosciences.elewa.org
Addass, P. A., Midau, A., Milka, M., & Tizhe, M. A. (2010). Assessment of Abattoir foetal wastage of cattle, sheep and goat in Mubi main Abattoir Adamawa State. Nigeria. World Journal of Agricultural Science, 42(2), 2876–2881. http://www.idosi.org/wjas/wjas6(2)/3.pdf
Adebowale, O. O., Adeyemo, O. K., Awoyomi, O., Dada, R., & Adebowale, O. (2016). Antibiotic use and practices in commercial poultry laying hens in Ogun State, Nigeria. Revue d’élevage et de médecine vétérinaire des pays tropicaux, 69(1), 41–45. https://doi.org/10.19182/remtv.31170
Adeyemi, A. B., Adamu, M., Dowsuda, P. M., & Oyedipe, E. O. (2016). The economic implications of foetal wastage in cattle, sheep and goats in Makurdi abattoir, Benue State, Nigeria. Nigerian Veterinary Journal, 37(4), 198–205.
Akpobio, U., & Babololo, S. (2014). Incidence of foetal wastage and its economic implications in cattle slaughtered at Abak slaughterhouse, Abak, Akwa-Ibom State. Journal of Reproduction and Infertility, 5(5), 65–68.
Alhaji, N. B. (2011). Prevalence and economic implications of calf foetal wastage in an abattoir in North Central Nigeria. Tropical Animal Health and Production, 43(3), 587–590. doi:10.1007/s11250-010-9735-7
Alhaji, N. B., & Odetokun, I. A. (2013). Food security and economic implications of small ruminant foetal wastages in Nigeria: A case of an abattoir. Livestock Research for Rural Development, 82(1), 1010–18.

Article #79. Retrieved July 15, 2020, from. http://www.lrrd.org/lrrd25/5/alha25079.htm

Alhaji, N. B., Odetokun, I. A., Shittu, A., Onyango, J., Chofe, U. M., Abubakar, M. S., Muraina, I. A., Foyomi, F. O., & Lee, H. S. (2015). Time-series analysis of ruminant foetal wastage at a slaughterhouse in North Central Nigeria between 2001 and 2012. Onderstepoort Journal of Veterinary Research, 82(1), 1–13. https://doi.org/10.4102/ojvr.v82i1.1010

Ardo, M. B., Lawal, H., & Aliyaro, Y. H. (2011). Economic implication of bovine foetal wastage in Yola modern abattoir, Adamawa State, Nigeria. International Journal for Agro Veterinary and Medical Sciences, 7(2), 57–64. https://doi.org/10.5455/ijavms.202

Atawalno, J., Emike, B. O., Shaibu, E., Mensah, A., Eyerere, O. D., & Folkite, R. D. (2011). Incidence of fetal wastage in cattle slaughtered at the Kumasi Abattoir, Kumasi, Ghana. Global Veterinary, 11(4), 399–402. DOI: 10.5829/diosig.2011.11.4.76104

Awoyomi, O. J., Awoyomi, S. O. F., & Talabi, A. O. (2013). Incidence of foetal wastage and economic implication on national herd replacement: A case study of Lafenwa Municipal Abattoir Ogun State, Nigeria. African Journal of Livestock Extension, 11, 52–57. https://www.aajo.info/index.php/ajlex/isssue/view/10658

Baba, B. O., Ojo, C., & Abdul, T. (2018). Economics in Ewes’ Gestation Termination in Maiduguri Abattoir, Borno State, Nigeria. International Journal of Innovative Research and Studies, 5(5), 45–48. http://www.jiiran.com/may-issue-2018/2

Bellieni, C. V., & Buonocore, G. (2012). Is foetal pain a real evidence? Journal of Maternal Fetal and Neonatal Medicine, 25(8), 1203–1208. https://doi.org/10.3109/14767058.2011.632040

Bello, A., Umar, M. A., Saidu, B., Garba, S., Jibir, M., Mahmuda, A., Hena, S. A., Raji, A. A., Baraya, Y. S., & Abubakar, A. A. (2012). Camel foetal wastage in Sokoto. Sokoto Journal of Animal Science, 1(5), 166–170.

Bokko, P. B. (2011). Pregnancy wastage in sheep and goats in the Sahel region of Nigeria. Nigerian Veterinary Journal, 32(2), 120–126.

Cadmus, S. I. B., & Adesokan, H. K. (2010). Bovine foetal wastage in Southwestern Nigeria: A survey of some abattoirs. Tropical Animal Health and Production, 42(4), 617–621. https://doi.org/10.1007/s11250-009-9465-x

Dunko, H. I., Buba, D. M., Gurnumyn, Y. G., Orogwo, A. O., Ozigbe, S. D., & Patrobas, M. N. (2017). Economic losses associated with slaughter of pregnant animals in Jos Abattoir. International Journal of Advance Research, 5(7), 1047–1052. https://doi.org/10.21474/ IJAR01/4813

Foyemi, P. O., & Muchenje, V. (2013). Maternal slaughter at abattoirs: History, causes, cases and the meat industry. SpringerPlus, 2(1), 125–131. https://doi.org/10.1186/2193-1801-2-125
Food and Agriculture Organization (FAO) (2013). Current worldwide annual meat consumption per capita, Livestock and Fish Primary Equivalent. http://faostat.fao.org/site/610/DesktopDefault.aspx?PageID=610

Food and Agriculture Organization (FAO) (2016). Stocks of cattle, sheep and goats for Nigeria (2012). http://faostat.fao.org

Hassan, D. I., Adua, M. M., & Yusuf, N. D. (2016). Incidence of foetal wastage in cattle slaughtered at the Lafia abattoir, Nasarawa State. Nigerian Journal of Agriculture, Food and Environment, 12(2), 200–202.

Maurer, P., Lücke, E., & Riehn, K. (2016). Slaughter of pregnant cattle in German abattoirs – Current situation and prevalence: A cross-sectional study. BMC Veterinary Research, 12(1), 91–99. https://doi.org/10.1186/s12917-016-0719-3

More, S., Bicout, D., Botner, A., Butterworth, A., Calistri, P., Depner, K., Edwards, S., Garin-Bastuji, B., Good, M., Schmidt, C. G., Michel, V., Miranda, M. A., Nielsen, S. S., Velarde, A., Thulke, H., Sihvonen, L., Spoolder, H., Stegeman, J. A., Roj, M., Willeberg, P., ... Winckler, C. (2017). Animal welfare aspects in respect of the slaughter or killing of pregnant livestock animals (cattle, pigs, sheep, goats, horses). European Food Safety Authority Journal, 15(5), 4782–4878. https://doi.org/10.2903/j.efsa.2017-4782

Müller, O. (2005). Malnutrition and health in developing countries. The Canadian Medical Association Journal, 173(1), 279–286. https://doi.org/10.1503/cmaj.050342

Mutwedu, V. B., Buumo, B. K., Mushagalu, A. C., Bisimworo, N. P., Cirezi, N. C., Mugumaahahama, Y., & Ayagirew, R. B. B. (2019). Prevalence and economic losses of calf foetal wastage in ELAKAT public slaughterhouse of Bukava, Democratic Republic of Congo. Veterinary World, 12(10), 1644–1649. https://doi.org/10.14202/vetworld.2019.1644-1649

Ngbede, E. O., Heno, S. A., Oguntoye, O. O., Tarhelyn, R., & Bulus, C. (2017). Bovine foetal wastage and its economic implication: A six-year (2003 – 2008) retrospective study in an abattoir in Northwestern, Nigeria. Scientific Journal of Veterinary Advances, 1(2), 42–46. http://www.sjournals.com/index.php/sjvja/index/view/article/274

Ngbede, E. O., Heno, S. A., Oguntoye, O. O., Tarhelyn, R., & Bulus, C. (2017). Bovine foetal wastage and its economic implication: a six-year (2003 – 2008) retrospective study in an abattoir in Northwestern, Nigeria. Scientific Journal of Veterinary Advances, 1(2), 42–46

Nma, B. A. (2011). Prevalence and economic implications of calf foetal wastage in an abattoir in NorthCentral Nigeria. Tropical Animal Health and Production, 43(3), 587–590. doi:10.1007/s11250-010-9735-7

Nonga, H. E. (2013). A review on cattle foetal wastage during slaughter and its impacts to the future cattle herds in Tanzania. LRRD, 27(12), 251. Retrieved January 20 2019, from http://www.lrrd.org/lrrd27/12/nonga27251.html

Nwokpu, P. E., & Osakwe, I. I. (2007). Trends in volume and magnitude of foetal waste of slaughter animals (2000–2005) in Ebonyi State of Nigeria. Research Journal of Animal Science, 1(1), 30–35.

Oduwuwo, B. O., Raimi, C. O., Talabi, A. O., & Sogunle, O. M. (2013). Foetal losses from slaughtering pregnant cows at Lafenwa Abattoir in Abeokuta, South Western Nigeria. Global Journal of Biology, Agriculture and Health Sciences, 2(2), 38–41.

Ogunbode, M., & Oladele, G. M. (2016). Wastage of bovine conceptus through indiscriminate slaughter of pregnant cows at Bodija central abattoir Ilaban. Journal of Agriculture and Crops Research, 4(4), 60–65. http://www.sciencewebpublishing.net/jacr/archive/2016/June/pdf/Ogunbode%20and%20Oladele.pdf

Onyinye, J., Okorie-Kanu, O. J., Ezenduka, E. V., Okorie-Kanu, C. O., Anyaoha, C. O., Attah, C. A., Ejiofor, T. E., & Onwumere-IDolor, S. O. (2018). Slaughter of pregnant goats for meat at Nsukka slaughterhouse and its economic implications: A public health concern. Veterinary World, 11(8), 1393–1444. https://doi.org/10.14202/vetworld.2018.1339-1444

Raimi, C. O., Oduwuwo, B. O., & Bamgbaye, F. O. (2017). Slaughtered Cattle and Reasons for slaughtering cows in ember months at Lafenwa abattoir in Abeokuta, Nigeria. European Journal of Agriculture and Forest Research, 5(1), 1–8. https://www.eajournal.org/journals/european-journal-of-agriculture-and-forestry-research-ejafri/vol-5-issue-1-march-2017/slaughtered-cattle-reasons-slaughtering-cows-ember-months-lafenwa-abbottor-abeokuta-nigeria/

Schonfeld, H. C., & Hatt, N. G. (2012). Dietary protein quality and malnutrition in Africa. British Journal of Nutrition, 108(S2), 69–76. https://doi.org/10.1017/S0007114512002553

Swai, E. S., Ayhub, H., & Mhina, B. S. (2015). Incidence of foetal wastage in sheep and goats slaughtered at Tanga city abattoir, Tanga, Tanzania. Livestock Research for Rural Development, 27(10), 251. Retrieved January 20 2019, from http://www.lrrd.org/lrrd27/10/swai27213.html

Teimirost, C., Wakayo, B. U., Mohammed, O., & Dewo, T. F. (2015). Small ruminant foetal wastage at Assella Abattoir in Central Ethiopia: Reflection on potential country level implications. International Journal of Livestock Research, 5(11), 55–61. https://doi.org/10.5455/ijl.201510050105350

Tasiame, W., Emikpe, B., Folist, R. D., Fofie, C. O., Johnson, S., Burimunoh, V., Atawalnu, J., Boateng, E., & Amemor, E. (2016). Foetal wastage in sheep and goats at the Kumasi Abattoir in Ghana: A Cross-Sectional Study. Archives of Basic Applied Medicine, 4(3), 95–98. http://archivesbamului.com/ojs/index.php/abam/article/view/1812

Uduak, A., & Samuel, B. (2014). Fetal Wastage in Goats Slaughtered at Trans-Amadi Abattoir Port-harcourt, Nigeria. Global Veterinaria 13(2), 255–257
