



Economic Implication of Foetal Wastages through Slaughter of Pregnant Pigs: A Case Study of the Makurdi Municipal Abattoir in Benue State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author POA coordinated data collection, performed the economic analysis and wrote the manuscript. Authors KAT and LIM collected field data, performed statistical analysis and wrote the protocol. Author CAK designed the study and supervised every stage of the research work and manuscript preparation. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study was designed to determine the economic implication of foetal wastages through the slaughter of pregnant pigs (sows/gilts).

Study Design: Longitudinal study.

Place and Duration of Study: The municipal abattoir in Makurdi, Benue State, Nigeria served as the main source of empirical data. The abattoir was visited daily for 120 days over a period of 4 months (September to December, 2012).

Methodology: At each visit, the number and sex of pigs slaughtered, number of pregnant sows/gilts slaughtered, number of foetuses wasted and ages of the foetuses (which also indicated the stage of pregnancy of the dam) were recorded. A deterministic economic model was used to estimate the

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foregone revenues resulting from slaughter of pregnant sows.

Results: A total of 2095 pigs were slaughtered of which 39.46% were male and 60.54% were female. The total number of fetuses wasted was 969, revealing a monthly average of 242. The prevalence of pregnant female slaughtering was 9.0% whereas prevalence of foetal wastage was 76.55%. Frequency of foetal wastage decreased with increase in stage of pregnancy and the average male to female sex ratio of wasted fetuses was 45.76:56.24.

Foregone revenue for a single wasted foetus was estimated at ~~₦11,400~~₦17,400.00 (\$32.02-\$48.88), while the average daily, monthly and annual foregone revenues of the abattoir were ~~₦75,292.25~~₦114,919.75 (\$211.50-\$322.81), ~~₦2,258,767.50~~₦3,447,592.50 (\$6,344.85-\$9,684.25) and ~~₦27,105,210.00~~₦41,371,110.00 (\$76,138.23-\$116,210.98) respectively.

Conclusion: Curbing this huge economic waste through purposefully developed strategies (by both government and non-governmental organizations) as well as strictly supervised interventions is highly advocated.

Keywords: Foetal wastage, pregnant female slaughtering, deterministic model, Nigeria.

1. INTRODUCTION

Sustainable swine production has been identified as a panacea to the prevailing animal protein shortage for several reasons, including their high fecundity, short generation interval, high feed conversion efficiency, early maturity and relatively small space requirement [1]. The importance of pork in human nutrition has also been demonstrated by the fact that 44% of world meat consumption is derived from pork and pork products [2]. In Nigeria however, the pig population has not experienced the expected growth commensurate to its potentials. Rather, between 1997 and 2002, the pig population in Nigeria declined from about 7 million to 5.1 million [3]. This reflects the fact that swine production is largely practiced by resource-poor farmers with poor management skills and are prone to detrimental practices like selling pregnant sows/gilts for slaughter; thus, forfeiting the growth of the flock and future profits for immediate financial relief.

The wastage of fetuses through the indiscriminate slaughter of pregnant livestock is one practice that has been counterproductive to livestock production endeavours. It frustrates the efforts of breeders and nutritionists by contributing to the widening gap of animal protein requirements for humans [4]. It is a major limitation to the sustainability and growth of livestock populations in Africa [5]. However, this practice is still widespread in Nigerian abattoirs despite several prevalence reports from North Central [6,7] North East [8,9] North West [10,11] South East [12,13] and South West [14,15] regions of Nigeria. Some reasons considered as responsible for the persistent slaughter of pregnant livestock include farmers' ignorance of

the pregnancy status of the animals and the desperate financial condition of the farmers [16,17].

There is a need for current studies to explore the use of empirical evaluations in analysing patterns in foetal wastage from abattoirs and take the added step to quantify the associated economic losses [18]. It is expected that this will demonstrate the reality of the adverse effects of the practice more clearly. In Nigeria, economic losses associated with the slaughter of pregnant livestock have been estimated for cattle [19,6] small ruminants [20,7] and camels [21] but there is a dearth of similar investigations in pigs. Additionally, the economic evaluations of these cited studies are largely based on rather simplistic calculations and, in some cases, unrealistic assumptions. This study seeks to provide a realistic economic evaluation based on verified variables incorporated into a stable deterministic model, which can serve as a template for such estimations in other species or regions.

2. METHODOLOGY

2.1 Study Area

This study was carried out in a municipal abattoir for pigs at Wurukum, Makurdi, Benue State. It is located within the Wurukum market. Makurdi, a nodal town, is located on longitude 8°35'E and latitude 7°44'N in the tropical guinea savannah floodplain of River Benue, north-central Nigeria. The town has an annual rainfall of 1090 mm with dry and rainy seasons. The River Benue divides the town into north and south banks with most drains and effluents from the human activities flowing directly into it [22].

2.2 Data Collection

The survey was carried out over a 120-day period spanning from September to December, 2012. The researchers, who are veterinary personnel, confirmed the sex and pregnancy status of the pigs post slaughter. When a gravid uterus was identified, a knife was used to make an incision along the left and right uterine horns to check for the presence of foetuses. Designed data sheets were used to record the number and sex (when identifiable) of foetuses wasted per pregnant sow.

Pregnancy stages (1st, 2nd or 3rd trimester) were estimated by aging of foetuses based on their crown-rump length, using a measuring tape and computing with the formula, $3(y+21)/\text{day}$; where y =length between crown to rump (cm), 3 = constant for swine, and 21= constant, plus certain other foetal morphological surface/external features.

2.3 Data Analysis

The data obtained in the course of this study was analysed using descriptive statistics such as tables and graphs, as well as quantitative analysis comprising of percentages. Prevalence of pregnant pig slaughtering (PPS) was determined as the proportion of the total number of slaughtered females (SF) that were pregnant (PF) at the time of slaughter, expressed in percentage as shown in equation [i] below. Whereas, the prevalence of foetal wastage (PFW) was determined by dividing the number of wasted foetuses (Wf) by SF and expressing the resultant value in percentage to represent the risk of foetal wastage associated with slaughtering any female pig (pregnant or not) as shown in equation [ii] below.

$$PPS = \frac{PF}{SF} \times 100 \quad [i]$$

$$PFW = \frac{Wf}{SF} \times 100 \quad [ii]$$

2.4 Estimation of Economic Loss from Foetal Wastage

A deterministic model was developed using Microsoft Excel[®] 2016 to demonstrate the economic implication of foetal wastages by slaughter of pregnant gilts/sows. The model determines the foregone revenue (FR) of a single wasted foetus i based on input values from reliable sources. The model then uses that

outcome (FR_{*i*}) to estimate the monthly (_{*m*}), daily (_{*d*}) and annual (_{*y*}) foregone revenues (FR_{*m*}, FR_{*d*} and FR_{*y*} respectively) for the Makurdi municipal abattoir. Table 2 shows the input values for variables used to develop the model and the sources from which they were derived. The calculations were as follows:

$$PP_i = W_6 \times Pkg \quad [iii]$$

$$TC_i = \sum(Fc_i, VS_i, Lc_i, Mc_i) \quad [iv]$$

$$FR_i = PP_i - TC_i \quad [v]$$

$$LM_m = \left[(FR_i \times Wf_m) \times \frac{M\%}{100} \right] \quad [vi]$$

$$FR_m = (FR_i \times Wf_m) - LM_m \quad [vii]$$

$$FR_d = \frac{FR_m}{30(\text{days})} \quad [viii]$$

$$FR_y = FR_m \times 12 (\text{months}) \quad [ix]$$

Where: PP_i = price of a mature pig; W_6 = average weight of a 6-month old pig; Pkg = price per kg of a pig; TC_i = total production costs for raising a single pig from birth to maturity; Fc_i = feed costs which covers all aspects of nutrition through all developmental stages; VS_i = veterinary service costs which includes the cost of drugs, vaccinations and veterinary consultation; Lc_i = labour costs which refers to salaries of farm attendants or managers; Mc_i = miscellaneous costs which covers all unforeseen costs; $M\%$ = percentage mortality and refers to the average proportion of pigs expected to die from other causes before maturity under average circumstances in Nigerian piggeries; LM_m = loss due to mortality per month.

3. RESULTS

During the four-month study period, a total of 2095 pigs were slaughtered of which 39.46% were male and 60.54% were female (Fig. 1). For each month, the number of slaughtered females was consistently higher than the number of males slaughtered. An average of 524 pigs were slaughtered monthly with the highest number of pigs slaughtered per month (587) recorded in December.

Out of all females slaughtered, 114 were pregnant while 1,151 were not pregnant. The total number of foetuses wasted during the four-month study period was 969, revealing a monthly average of 242 wasted foetuses. The highest

monthly prevalence of pregnant slaughtering (12.50%) and foetal wastage (111.72%) was recorded in November. However, for the entire study period, the average prevalence of pregnant slaughtering was 9.0% whereas that of foetal wastage was 76.55% (Table 1).

^a PPS represents the prevalence of pregnant pig slaughtering calculated according to equation [i]

^b PFW represents the prevalence of foetal wastage calculated according to equation [iii] to demonstrate the risk of foetal wastage associated with the slaughter of sows/gilts.

The frequency of foetal wastage decreased with increase in age of pregnancy with the 1st trimester accounting for 59.75%, 2nd trimester accounting for 29.62% and 3rd trimester accounting for only 10.63%. Gender determination could not be conclusively performed for 1st trimester foetuses; however, it was done for 2nd and 3rd trimester foetuses. The frequency of female foetuses was higher than that of male foetuses in both trimesters, giving an

average male to female sex ratio of 45.76:56.24 (Fig. 2).

The calculated values for losses due to foetal wastage as a result of slaughtering pregnant sows/gilts are shown in Table 2. However, foregone revenue for a single wasted foetus was estimated at ₦11,400-~~₦17,400.00~~ (\$32.02-\$48.88), while the average daily, monthly and annual foregone revenues (taking losses due to mortality into account) were ₦75,292.25-~~₦114,919.75~~ (\$211.50-\$322.81), ₦2,258,767.50-~~₦3,447,592.50~~ (\$6,344.85-\$9,684.25) and ₦27,105,210.00-~~₦41,371,110.00~~ (\$76,138.23-\$116,210.98) respectively.

^a Experts refers to the pig traders, butchers and pork sellers who provided the respective values via personal communication. ^b ₦750-~~₦850~~ is the current market price range of 1kg of a pig (live weight) and the estimated foregone revenues are highly dependent on fluctuations of this value. ^c242 is the average number of foetuses wasted/month over the four months of field survey at the Makurdi municipal abattoir.

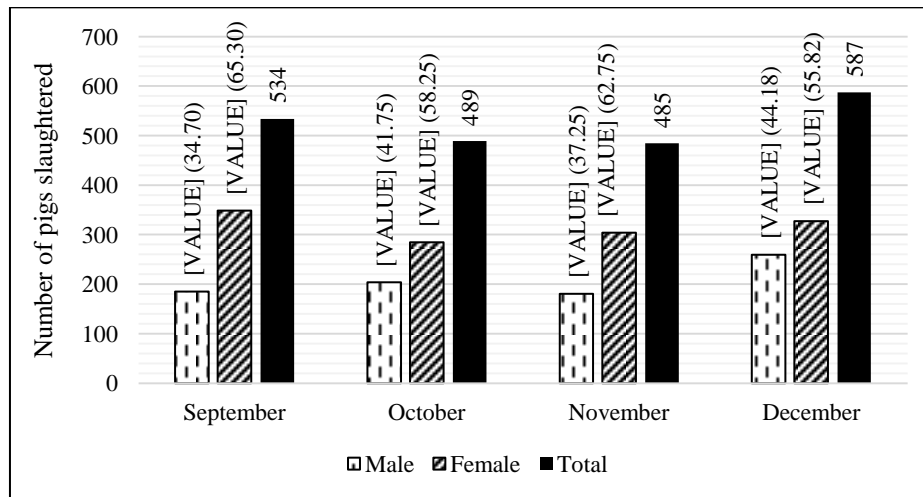


Fig. 1. Monthly frequency of female (%) and male (%) pigs slaughtered at the Makurdi municipal abattoir

Table 1. Monthly Summary of slaughtered sows/gilts (non-pregnant and pregnant) and foetal wastages in Makurdi Abattoir from September to December, 2012

Month	Sows/gilts slaughtered	Non-pregnant sows/Gilts slaughtered	Pregnant sows/gilts slaughtered (PPS ^a)	Number of wasted foetuses	PFW ^b
September	349	325	24 (6.80 %)	197	56.46%
October	285	266	19 (6.67 %)	169	59.17%
November	304	265	38 (12.50)	340	111.72%
December	328	295	33 (10.14 %)	264	80.43%
TOTAL	1265	1151	114 (9.0 %)	969	76.55%

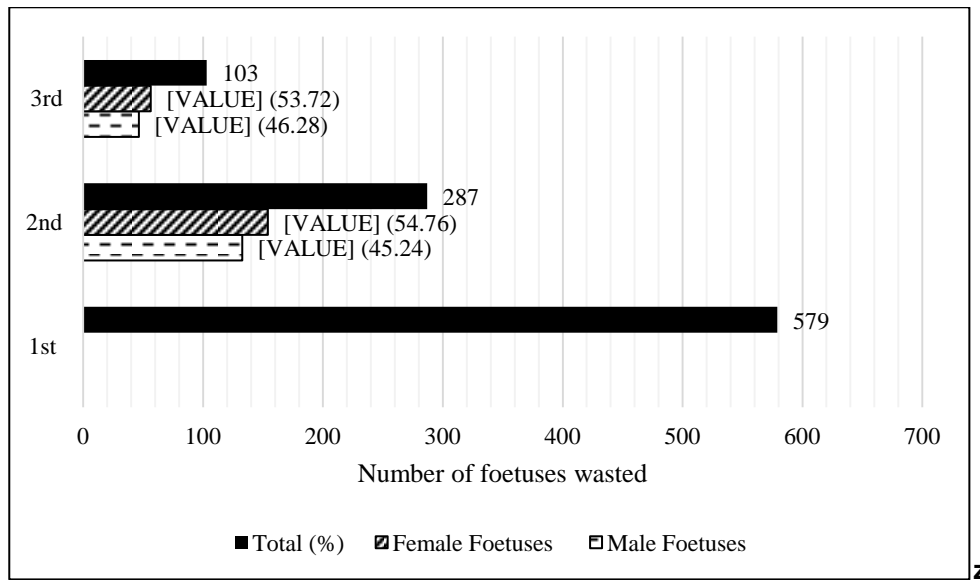


Fig. 2. Frequency of female (%) and male (%) foetuses wasted in the 1st, 2nd and 3rd trimesters of pregnancy

Table 2. Variables used in the economic analysis, the sources from which they were obtained and the calculated values

Variable	Abbreviation	Value	Source
Average weight at 6months	W_6	60 Kg	Experts
Price /kg (live weight)	Pkg	₦750 - ₦850	Experts
Average price of 1 adult pig	PP_i	₦45,000 - ₦51,000	Calculated
Feeding costs/head	FC_i	₦23,000.00	[1,23]
Veterinary supplies/head	VS_i	₦1,000	[1,23]
Labour costs/head	Lc_i	₦3,600	[23]
Miscellaneous costs/head	Mc_i	₦200	[23]
Average fixed cost/head	FC_i	₦5,800.00	[23]
Total production costs/head	TC_i	₦33,600.00	Calculated
Wasted foetuses/month	Wf_m	242 ^c	Field survey, 2012
Percentage mortality	M%	18.125%	[24,25]
Loss due to mortality/month	LM_m	₦500,032.50 - ₦763,207.50	Calculated

4. DISCUSSION

The finding of more female pigs being slaughtered than males was also observed by researchers in other livestock species from different abattoirs in Nigeria [26,21,27,28]. This poses a great danger to the reproductive efficiency and propagation of livestock populations, as many more females are required for reproduction purposes than males. The act of slaughtering female animals is therefore a deterrent to animal production and should be done with discretion [29].

The increase in number of pigs slaughtered in December could be associated with end-of-the-year festivities. The associated increase in price

of pigs at this period also encourages farmers to sell off their pigs at higher prices in order to meet their own (personal/family) increased needs for other commodities during the festive period.

The prevalence of pregnant slaughtering recorded in this study is similar to reports on ruminants [19,6,19] which recorded 14.4%, 10.24% and 4.02% respectively. However, the prevalence of foetal wastage recorded in this study (76.55%) is alarmingly high compared to 23.14%, 9.09%, 13.55% reported for other livestock [21,30,7] respectively. This disparity is attributable to the much higher fecundity of sows in comparison with cows, ewes or does, which were the subjects of the cited studies. In fact, the prevalence of foetal wastage recorded in

November was greater than 100% because the number of wasted foetuses was greater than the number of all slaughtered females.

The much higher frequency of foetal wastage in the 1st trimester suggests that the farmers /butchers may have been unaware of the pregnancy status of the animals since pregnancy diagnosis was primarily by visual examination. The average sex ratio (male: female) of wasted foetuses found in this study showed that more female foetuses were wasted. Reports on camels [21] and on cattle [6] show similar figures (47.76:52.24 and 45.5:54.5 respectively). This finding buttresses the fact that nature supports reproductive efficiency and population growth by providing more females. Nevertheless, continuous foetal losses will continue to exert a negative effect on the national pig population if left unchecked.

In this study, the estimation of economic losses was based on verified values and realistic considerations. For example, the deterministic model took the percentage mortality of pigs raised to maturity into account. This is an improvement over previous similar studies from the region which might have overestimated figures. However, the estimates of daily, monthly and annual economic losses in this study surpasses losses estimated for cattle [19,6], small ruminants [20,7] and camels [21] in Nigeria. Foetal wastages through slaughter of pregnant sows/gilts may therefore be considered the most economically devastating among livestock species in which slaughter of pregnant females occur. In Nigeria, where more than 50% of the populace currently live below the international standard poverty threshold of \$1.9 a day, this finding is definitely critical.

5. CONCLUSION

Results from this study, as well as other recent studies indicate that foetal wastage is occurring on a massive scale in Nigerian abattoirs. However, the much higher fecundity of pigs in comparison with other livestock species makes the slaughter of pregnant sows/gilts more economically devastating than the slaughter of pregnant females of other livestock species.

The assertion that foetal wastages occur largely due to human negligence at our abattoirs should be taken seriously because the effects are far reaching. Curbing this huge economic waste through purposefully developed strategies (by

both government and non-governmental organisations) as well as strictly supervised interventions will definitely go a long way in relieving poverty among pig farmers. There is however a need for proper analysis of economic losses associated with foetal wastages among other livestock species using standard empirical evaluations.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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