ASSESSMENT OF ANIMAL WELFARE, SLAUGHTER PRACTICES AND FOOD SAFETY IN BHUTAN

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ABSTRACT: *This study assessed the animal slaughter practices and welfare standards in Bhutan with an aim to identify best practices for animal slaughtering that is suitable and applicable in the country. The study was conducted in Chukha, Dagana, Samdrupjongkhar, Samtse, Sarpang and Tsirang districts where majority of meat is being produced. A total of 749 respondents were involved which included 200 broiler farms, 548 pig fattener farms and one cattle abattoir across six districts. The results revealed substantial reliance on makeshift slaughtering (86.6%) followed by 12.7% slab slaughtering and 0.7% modern slaughtering facility. Overall, 78.4% of the respondents did not restrain animals prior to slaughter and 82.6% of the broiler and fattener farms did not use any stunning methods. A meager 3.7% of the farm and abattoir personnel reported having some formal training on stunning and slaughtering methods. Out of 18.5% (n=37) broiler farms that used stunning, 29 farms deployed mechanical stunning through blunt object hit and eight farms used electrical stunning. Similarly, out of 16.8% (n=92) fattener farms, 91 farms used mechanical stunning (two captive bolt and 89 sharp/blunt object hit) and one electrical stunning methods. The cattle slaughterhouse used mechanical stunning through sharp object hit behind the nuchal crest. Among various methods of animal slaughter, 48.5% of broiler farms used suffocation method followed by 30.0% manual neck dislocation, 6.0% decapitation, 5.5% each by bleeding and thoracic stick and 2.5% strangulation. Similarly, 97.6% of fattener farms used chest stick for slaughtering pigs followed by 1.8% strangulation, 0.4% suffocation and 0.2% bleeding after stunning. The cattle slaughterhouse used bleeding by severance of blood vessels in the neck after stunning. Overall, this study revealed significant variations in methods and standards of animal slaughtering practices impacting meat hygiene and safety, and compromising animal welfare. In the absence of standard slaughter facilities and prescribed slaughtering methods, lack of competent personnel for animal slaughtering and to minimize risks to personnel, this study recommends the use of captive bolt in cattle and pigs and electrical in poultry as the best method for stunning. This should be followed by suitable slaughter methods either through bleeding by neck stab and chest stick in cattle and pigs and by neck severing in poultry; ensuring welfare of food animals at all times during entire stages preceding the death of an animal. 53.6% of the farms fulfilled the standards prescribed for transportation of meat indicating the poor meat quality and safety thereby highlighting the need to emphasize the strict enforcement of Livestock Rules and Regulations 2017.*

Keywords: Animal welfare; Broiler farm; Cattle abattoir; Fattener farm; Food animal; Humane slaughter; Meat hygiene; Slaughter practice

1. INTRODUCTION

Animal husbandry and slaughter practices are integral to agrarian communities (FAO 2021). The slaughter of animals for human consumption has been practiced since the domestication of food animals in prehistoric times (Shimshony and Chaudary 2005). Slaughtering of animals is an inevitable part of the food production cycle despite being

the most brutal act (Shimshony and Chaudary 2005). The slaughtering process is vital not only for animal welfare but also for meat quality, safety and public health (Aghwan 2018).

The methods of slaughter vary across different cultures and religions and over the time, have evolved with advances in technology (Aghwan and Mac-Regenstein 2019). The four methods that are most prevalent globally are Halal (Muslim), Kosher (Jewish), Industrial (stunning) slaughter and Jhatka (Sheik); the latter being the least commonly practiced (Aghwan 2019). Irrespective of the slaughter methods and significance of religious requirements and the ritual, cultural and ethnic factors, it is essential to minimize animal suffering throughout the pre-slaughter and slaughter processes (Shimshony and Chaudary 2005). The World Organization for Animal Health (WOAH) has included chapters on guidelines for the slaughter of animals for human consumption in its *Terrestrial Animal Health Code*. This is intended to provide framework within which certain steps in the process may be practiced to improve animal welfare or at least not to compromise (Shimshony and Chaudary 2005). The WOAH member countries are expected to incorporate these guidelines into their standards, enact relevant regulations and implement the guidelines (Shimshony and Chaudary 2005).

The animal slaughter, meat hygiene and inspection in Bhutan are regulated by the Livestock Act of Bhutan 2001 and Food Act of Bhutan 2005 (Dorjee 2011). The animal slaughtering, fresh meat hygiene and

inspections is guided by the Livestock Rules and Regulations of Bhutan 2017, which came into enforcement from 2009 onwards. Bhutan Food and Drug Authority (BFDA) is the authorized agency to enforce the legislation. BFDA is responsible for meat hygiene and meat inspection duties. The veterinarians and the diagnostic laboratory technicians under the Department of Livestock (DoL) provide technical support to the Regulatory Inspectors under BFDA.

The animals brought for slaughter in the abattoirs are subjected to traditional ante-mortem (AM) and post-mortem (PM) inspections as per standards and procedures established for AM and PM inspections under the Livestock Rules and Regulations 2017 (Dorjee 2011). This code of AM and PM inspections requires to be applied throughout the food chain, starting at the farm of origin, so that fresh meat produced from the slaughtered animals is safe for human consumption (MoAF 2001). The carcasses are classified as fit for consumption or condemned based on the physical health condition of the animal while at lairage along with the findings for the presence or absence of pathological lesions during the inspection (Dorjee 2011). However, it has been found challenging to implement these standards at the field level for various technical and logistical reasons (Dorjee 2011).

The humane treatment, welfare standards and welfare inspection of food animals are important components in the Livestock Act of Bhutan (MoAF 2001). All food animals slaughtered are required to be slaughtered humanely by stunning using appropriate

method prior to slaughter (MoAF 2017). The animal welfare requirements and standards are prescribed right from the time of loading of the animals from the place of origin to the period leading up to the restraint and slaughter including the slaughterhouse designs (MoAF 2017).

As per the Livestock Act of Bhutan 2001, the slaughter of animals and sale of meats on the auspicious days of 8th, 15th, 30th, 4th day of 6th month, 22nd day of 9th month and during the whole of 1st and 4th months of the Bhutanese calendar year are prohibited (MoAF 2001; MoAF 2017). The slaughterhouses and meat shops are closed during these auspicious days and months (Dorjee 2011). The hoteliers and restaurants are also banned from serving fresh meats during these auspicious occasions throughout the country (Dorjee 2011). As a result, the numbers of animals slaughtered in the days prior to 1st and 4th months of the Bhutanese calendar are substantially higher compared to the normal daily averages in order to stock the meat and meet the demands during the restricted periods (Dorjee 2011).

Meat forms an indispensable part of the Bhutanese diet which includes beef, pork, chicken, chevon, mutton, yak meat and fish (Fuller et al. 2005). Although, fresh meat is consumed, many Bhutanese prefer dried meat (Fuller et al., 2005). In 2023, the country produced a total of 4668.49 metric tons (MT) of meat and meat products including fish (NSB 2023). Out of this, 1590.47 MT was pork, 1474.82 MT beef, 141.63 MT yak meat, 230.69 MT chevon, 22.50 MT mutton, 1165.12 MT chicken and 43.26 MT fish (NSB 2023). Chukha, Dagana, Samdrupjongkhar, Samtse, Sarpang

and Tsirang districts produced 80.69% (3767.04 MT) of the country's total meat and fish production (NSB 2023).

The demands for meat especially pork, beef and chicken are increasing steadily in Bhutan. The five-year moving average of meat production from 2006 to 2023 showed increasing trend in the pork, beef and chicken production (NSB 2023). However, the production of other meats such as chevon, mutton, fish and yak meat showed a minimal change over the years (NSB 2023). Similarly, a total of 7370.51 MT of meat and meat products including fish, crustaceans and mollusks worth of BTN 1.400 billion was imported in 2023 (DRC 2023). The import of fresh, chilled or frozen beef, pork and chicken comprised of 1961.36 MT, 1.14 MT and 2583.16 MT respectively (DRC 2023). The import of meat and meat products, fish, crustaceans and mollusks was 7840.16 MT worth of BTN 1.151 billion during 2018 which is a decrease of about 5.99% during 2023 in the country (DRC 2018).

The abattoir sector has been neglected in most national livestock development programs throughout Asia and the Pacific (FAO 2008). In Bhutan, inadequate animal slaughtering facilities and poor meat handling practices are still a major problem (Dorjee 2011). Currently, there are no established slaughterhouses for poultry and pigs in the country and slab slaughtering of birds and pigs is done within the farm premises. Fresh chicken and pork are then transported in specially designed vehicles or refrigerated vehicles and distributed to the meat retailers. It is mandatory for the

retailers to have minimum specified cold chain facilities/chilling room as per the Livestock Rules and Regulations 2017.

For cattle slaughter, two medium-sized modern cattle abattoirs were established in Phuentsholing and Samdrupjongkhar districts during the mid eighties under Asian Development Bank (ADB) project with an objective to facilitate culling of unproductive animals in the country (Dorjee 2011). These abattoirs ceased operation from mid 2002 mainly because of socio-cultural reasons (FAO 2008) and due to unsuitable location leading to environment pollution, difficulty in sourcing animals for slaughter and other management associated problems (Dorjee 2011). Currently, there is one privately operated traditional cattle slaughterhouse in Tsirang district with low to medium capacity. This slaughterhouse supplies hot (unrefrigerated) beef to traditional meat markets in the nearby districts.

Although it is mandatory for the farm owners, slaughterhouses and the meat retailers to have minimum specified requirements, the standards of slaughter practices and hygiene are generally low posing threat to the consumers and workers (Dorjee 2011). Moreover, in the absence of standard slaughter facilities, prescribed slaughtering methods and lack of competent and trained personnel for slaughtering, the animal welfare is being compromised.

The animal slaughter practices directly affect the hygiene and quality of meat. Further, the animals are also potential source of zoonotic and food borne diseases. Limited studies have been conducted to assess the prevalence of zoonotic and food borne diseases during the slaughtering operations. However, the study conducted by Dorjee (2011) reported the prevalence of zoonotic

diseases in cattle at 7.3% hydatidosis, 2.2% fascioliasis, 1.1% brucellosis, 0.8% tuberculosis and 0% cysticercosis in Tsirang slaughterhouse. The microbiological assessment of deep tissue samples in this slaughterhouse revealed 15.8% positive to Salmonella and the mean total aerobic bacterial count in fresh cattle meat was $6.14 \pm 1.46 \log_{10}$cfu/g (Dorjee 2011).

Since livestock is important to the economy and social structure of the country, risks from zoonotic and food borne diseases are a constant threat. The poor hygiene and inhumane ways of slaughtering in the farms and existing slaughterhouse is a major concern to the Ministry of Agriculture and Livestock (MoAL) and there is an urgent need to address and ensure best practices and welfare of food animals during the pre-slaughter and slaughter processes. This study was conducted to assess the animal slaughter practices and welfare and to identify and adopt best practices for animal slaughtering that is suitable and applicable in Bhutan.

2. MATERIALS AND METHODS

2.1 Study area and period

The study was conducted in Chukha, Dagana, Samdrupjongkhar, Samtse, Sarpang and Tsirang districts where majority of the meat is being produced (Figure 1). The study population included one cattle slaughterhouse and 254 subsistence, 394 semi-commercial and 100 commercial broiler and piggery farms including government poultry and piggery farms across six districts. The study was carried out during May and June 2024.
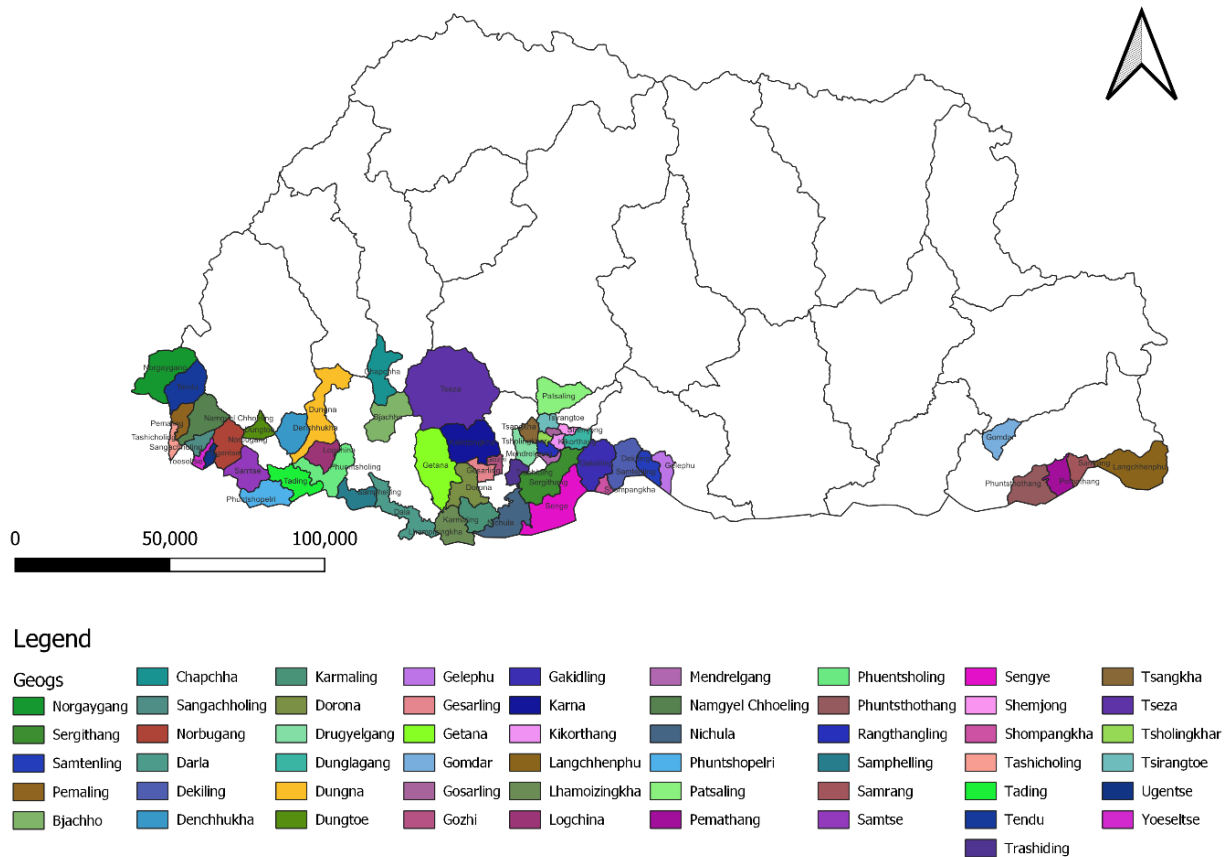
Figure 1: Study sites for animal slaughter practices in Bhutan

2.2 Sample size and sampling strategy

There were a total of 225 broiler farms and 583 fattener farms in the study areas and the sample size was determined using the Yamane's formula, resulting in a final sample size of 200 broiler farms and 548 fattener farms. Proportionate sampling was done for subsistence, semi-commercial and commercial broiler and fattener farms in each district and the farms were randomly selected for the study. Additionally, one cattle slaughterhouse in Tsirang, National Piggery Development Centre (NPiDC) in Gelephu and National Poultry Development Centre (NPDC) in Sarpang were also included in the sampling.

2.3 Study design

The study is a cross-sectional study to assess the animal slaughter practices in the cattle slaughterhouse, poultry and piggery farms in the country. A semi-structured questionnaire was developed to acquire information on slaughter facility, source, numbers and period of slaughter, slaughter personnel and competency, pre-slaughter process, stunning and slaughter methods, post-slaughter processes including challenges faced and ways for improving food animal slaughtering. The livestock personnel in the six districts were involved for the study and the data was collected using Epicollect5 mobile app.

2.4 Statistical analysis

All data entry, management and analysis were done using Microsoft Excel version 2010. Descriptive statistics were used to analyze the data and the results of study findings, applying percentages and frequencies. Data were analyzed using PHStat2 statistical analysis software.

3. RESULTS AND DISCUSSION

3.1 Sample characteristics

A total of 749 respondents were involved for the study. This included 200 broiler farms comprising of 29.5% subsistence (n=59), 39.0% semi-commercial (n=78) and 31.5% commercial (n=63). Similarly, out of 548 pig fattener farms surveyed, 35.4% were subsistence (n=194), 57.8% semi-commercial (n=317) and 6.8% commercial (n=37). NPDC and NPiDC were subsumed in the commercial farm category. In cattle, the only existing traditional cattle slaughterhouse was included for the survey.

3.2 Source of animals for slaughter

The study analyzed the sources of animals for slaughter in their respective premise. Substantial percentage of respondents (83.2%) sourced animals for slaughtering from within the farm followed by 11.3% outsourcing and 5.5% both on-farm and outsourcing as shown in Figure 2 (n=749).
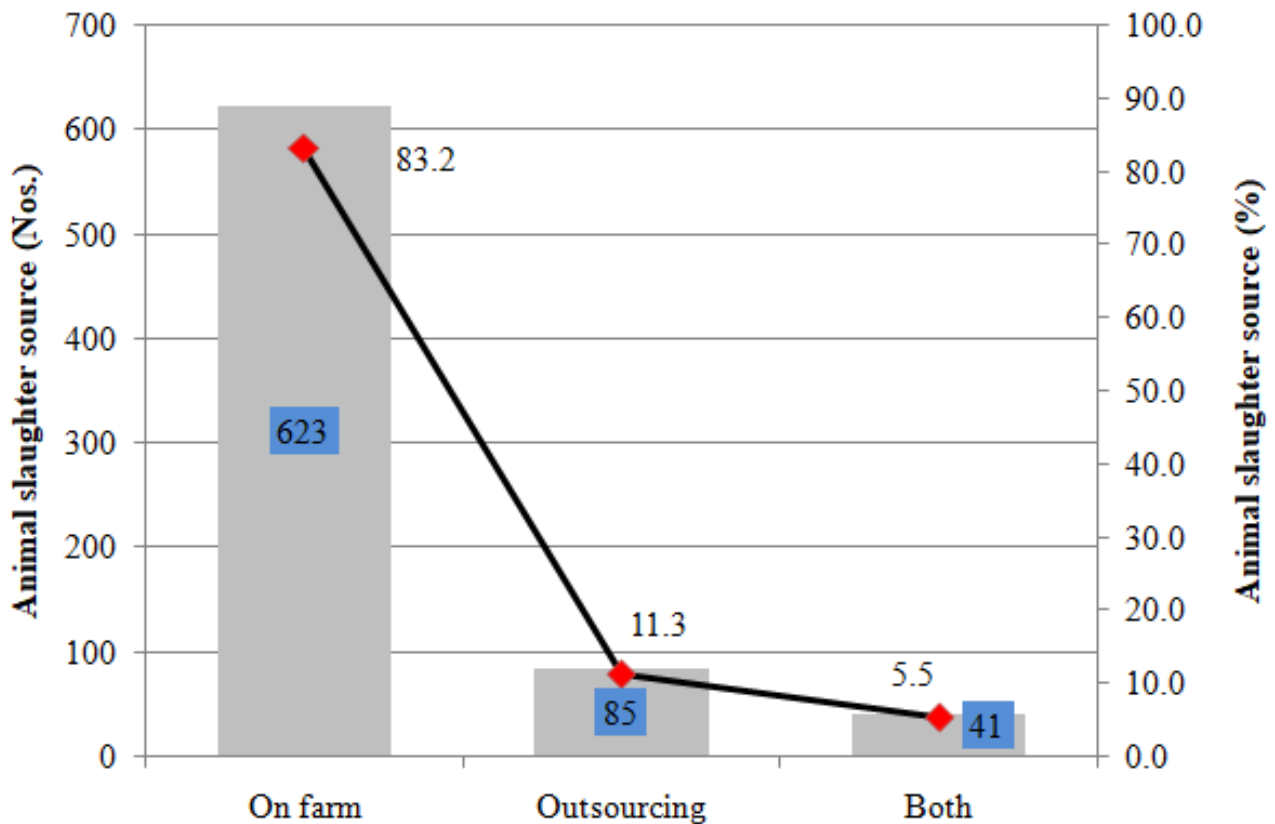

Figure 2: Animal slaughter source

In poultry slaughter, 77.5% of the respondents (n=155) reported the source exclusively from their own farms followed by 14.0% (n=28) from both own and nearby areas and 8.5% (n=17) relying solely on nearby farms. Among the study areas, Chukha, Dagana, Samdrupjongkhar, and Tsirang reported 100% sourcing from their own farms while Samtse and Sarpang used mixed sourcing as well as sourcing from outside alone at 65.4% and 43.3%, respectively.

In the piggery sector, 85.4% (n=468) of respondents reported slaughter source from their own farms, 12.2% (n=67) from nearby areas and 2.4% (n=13) using mixed sources. Dagana, Chukha, Samdrupjongkhar and Tsirang districts depend entirely on on-farm sources while minimal outsourcing was observed in Samtse (4.9%) and Sarpang (5.3%). As per the study, dual sourcing was observed in Sarpang (37.5%) and Samtse (33.0%) highlighting regional differences in sourcing practices for pig slaughters.

The lone cattle slaughterhouse in Tsirang operates by sourcing cows from within and nearby districts. This sourcing method indicates a distinct operational model, where the farm functions primarily as a processing facility rather than full-cycle cattle rearing operation. The reliance on external source reflects its resource constraints, such as limited land or feed availability, or a strategic approach to meet demand without the added costs of maintaining a large herd. This model also highlights the interconnectedness of local cattle farming and the role of smaller farms in sustaining the supply chain. It may influence future discussions on the scalability and sustainability of commercial cattle farming in Bhutan, considering both economic and logistical factors.

The pattern observed for sources of animal slaughter may be due to high demand during peak periods, as suggested by Mancinelli et al. (2018), who highlighted that on-farm processing is preferred for quality and supply chain control. Further, the high rates of within farm source for poultry and pig indicates strong local production capacity, possibly due to favorable conditions or established practices while mixed sourcing reflects a strategic response to supply and demand fluctuations (Astruc and Terlouw 2023; FAO 2021).

3.3 Average numbers of animals slaughtered

Figure 3 shows the weekly practice of broiler slaughtering by three different categories of broiler farms. 35.0% (n=70) of broiler farms slaughtered fewer than 10 birds per week followed by 31.5% (n=63) between 11-50 birds/week, 18.0% (n=36) between 51-100 birds/week, 14.5% (n=29) between 101-500 birds/week and only 1.0% (n=2) over 500 birds/week. The subsistence farms mostly practiced slaughtering less than 10 birds/week whereas the semi-commercial and commercial farms adopted slaughtering between 11-50 birds/week and 101-500 birds/week respectively.

This distribution indicates a predominance of smaller-scale operations, with 66.5% of farms slaughtering lesser than 50 birds/week. This aligns with FAO (2013), which notes the prevalence of small and medium-sized poultry operations, and highlights the need for targeted support for small-scale producers (FAO 2004).
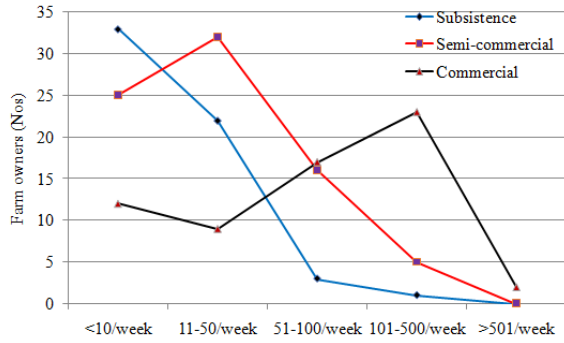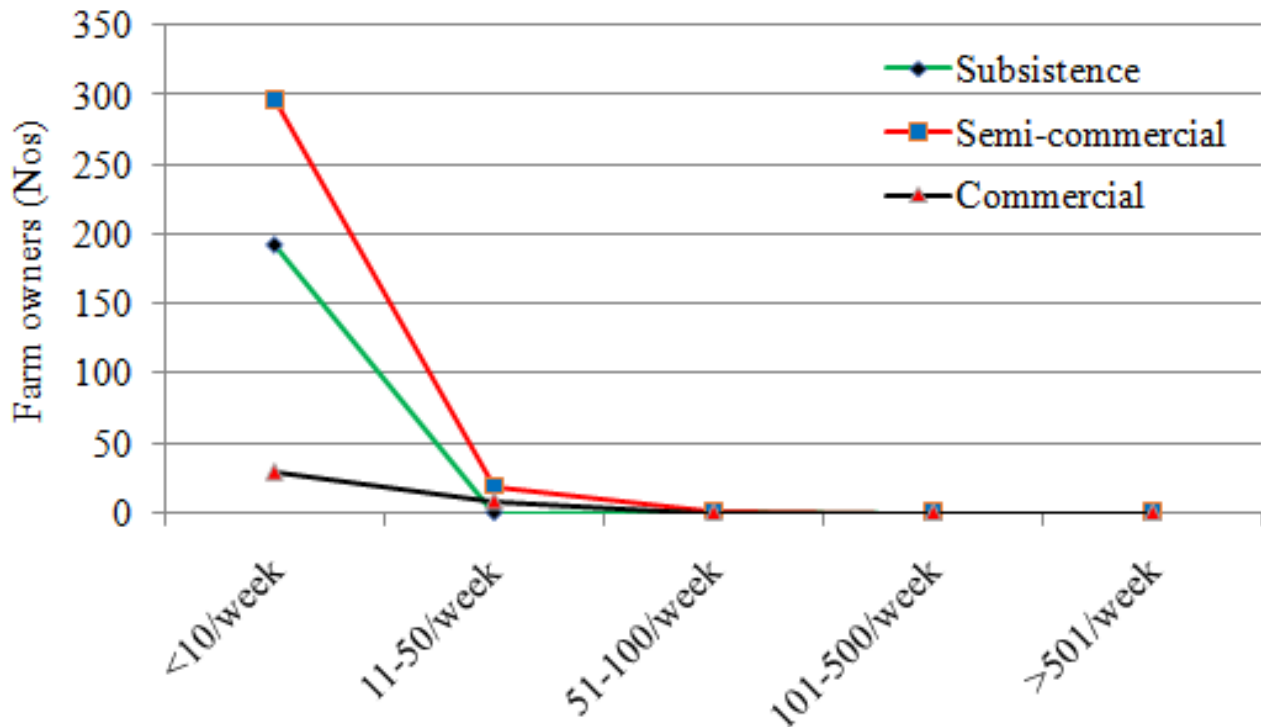
Figure 3: Weekly average slaughter practice in broiler farms

Among the pig fattener farms, 94.7% (n=519) practiced slaughtering fewer than 10 pigs/week, while 4.9% (n=27) slaughter 11-50 pigs/week and 0.4% (n=2) slaughter between 51-100 pigs. None of the farms practiced slaughtering more than 100 pigs per week in the study areas (Figure 4). Among the six districts, two farms in Chukha practiced slaughtering between 51-100 pigs/week.

Irrespective of subsistence, semi-commercial and commercial nature of fattener farms, the most common slaughter practiced was lesser than 10 pigs/week unlike in three categories of broiler farms. This highlighted the predominance of small-scale nature of pig slaughter operations in the country.

**Figure 4:** Weekly average slaughter practice in fattener farms

The cattle slaughterhouse in Tsirang reported less than 10 cattle being slaughtered per week. In contrast, Dorjee (2011) reported that the abattoir in Tsirang slaughtered on an average about 50 cattle/week indicating 80% difference compared to the present report. This discrepancy was validated with the AM and PM inspection reports available in the Dzongkhag Livestock Sector (DLS) in Tsirang. It was found that during the year 2023, a total of 2853 animals were presented by the slaughterhouse and subjected to AM and PM inspections. The average animals slaughtered was 54.9 cattle per week which showed that the figure reported by the owner was inconsistent.

3.4 Animal slaughter facility and design

Figure 5 shows the types of slaughter facility designs used for animal slaughter by broiler farms, fattener farms and cattle slaughterhouse. Overall, 86.6% use makeshift slaughtering (n=649) followed by 12.7% slab slaughtering (n=95) and 0.7% modern facility (n=5). In the absence of established abattoirs to slaughter poultry and pigs in the country, the preference for makeshift slaughtering by the poultry and pig farm owners might be due to minimal infrastructure requirements and lower costs, which are advantageous in regions with limited resources or smaller-scale operations (World Bank 2009). Slab slaughter represents a moderate adoption of more structured facilities, offering basic improvements in sanitation and efficiency compared to makeshift setups (Onah et al. 2021). It was observed that five (2.5%) broiler farms were using modern abattoir

system which included four in Samphelling Gewog and one in Phuntsholing Gewog. Although these farms claimed to have modern abattoir system, the report might be restricted to use of some modern facilities like electrical stunning, advanced scalding and de-feathering equipment, etc.
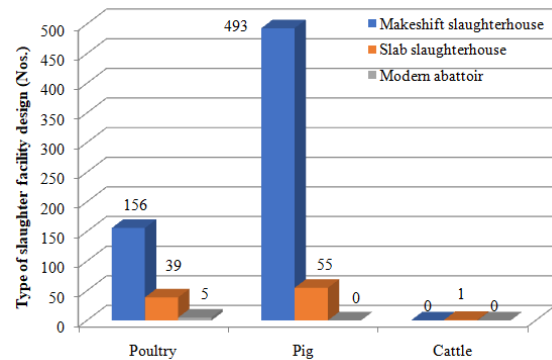
Figure 5: Types of animal slaughter facility design

The cattle slaughterhouse in Tsirang was built on five acres of land, features a designated slab slaughterhouse to address the increasing demand for meat. This facility is specifically designed to handle larger volumes and improve efficiency in meat processing, reflecting the efforts to scale up operations and meet the growing needs of the market. Similar findings on open slaughtering practices were reported by Thakur et al. (2012) during their study on meat inspection and animal welfare practices: evidences from north-western Himalayan region, India. This finding indicates that proper meat hygiene practices are being compromised, which have affected both quality and animal welfare. Therefore, it is crucial to strengthen animal welfare measures to ensure safe and high-quality meat production.
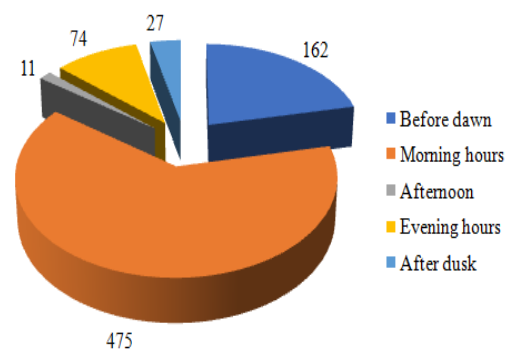
3.5 Period of animal slaughter

The most preferred period for animal slaughtering was assessed during the study as shown in figure 6. Overall, the broiler farms, fattener farms and cattle slaughterhouse revealed that the most conducive period for animal slaughtering was during morning hours (63.4%) followed by before dawn (21.6%), evening hours (9.9%), after dusk (3.6%) and afternoon hours (1.5%). Similar pattern was observed when compared within the poultry broiler and pig fattener farms. The predominant practice of conducting poultry slaughter in the morning hours suggests a preference for early processing. This timing may be linked to factors such as cooler temperatures, which can be more conducive to maintaining hygiene and ensuring the quality of meat (Jacobs et al. 2016).

3.6 Trend of food animal slaughter

Figure 7 illustrates the seasonal trends in the slaughter of food animals across the surveyed farms. Poultry and pigs are predominantly slaughtered during the months of January-early February and late March-April. The slaughtering and marketing chicken and pork also peaks during September-December. The high number of animals slaughtered prior to the 1st and 4th months of the auspicious Bhutanese calendar may be attributed to stockpile meat and meet demands during the ban periods.

In contrast, the sole cattle slaughterhouse in Tsirang reported higher numbers of slaughter of cattle during April-May and July-August months. This was in contradiction to the study done by Dorjee (2011) who reported that the number of cattle slaughtered and sale of meat in Tsirang abattoir increased rapidly towards the ban period and immediately after the relaxation of ban periods. The contamination trends were of similar pattern with that of number of animals slaughtered indicating that the hygiene of animals and slaughter premises were compromised during prior and start of relaxation of the ban periods.

Figure 6: Preferred period for animal slaughter

The findings reported by the cattle abattoir owner were validated with the number of cattle presented for AM and PM inspections to the DLS in Tsirang during the year 2023. The data showed that the number of cattle slaughtered during early February was the highest for the year with a mean of 54.17 ± 26.19 (n=325). Similarly, the mean animal slaughtered was 31.40 ± 7.30 during early May (n=157). No animals for slaughter were presented for AM and PM inspection during the late February-March and late May-early June months indicating inconsistency in abattoir owner's report. The *t*-test for differences in two means for cattle slaughtered before ban and post ban periods showed statistical significance ($p < 0.05$).
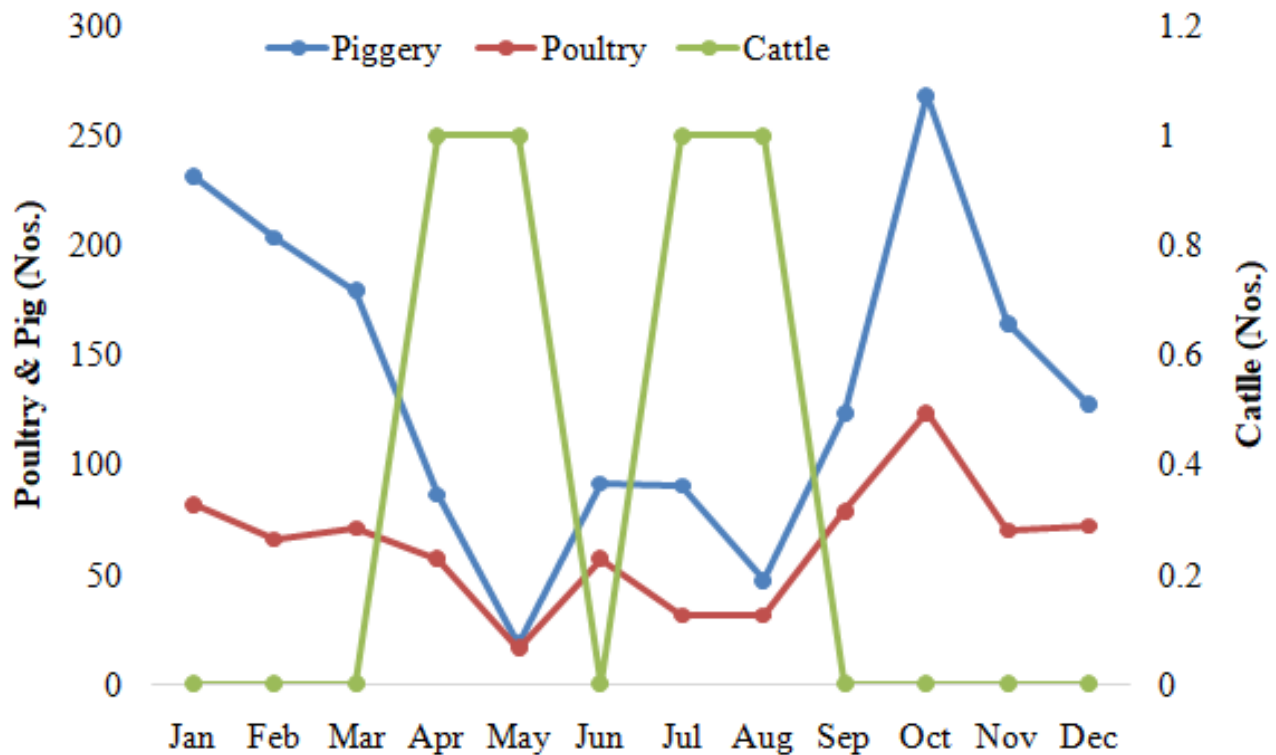
Figure 7: Trends of food animal slaughter

However, the slaughtering practice was similar to poultry and piggery farms which observed higher number of animals slaughtered during November, December and January months with a mean of 33.75±18.62 (n=405), 38.00±19.79 (n=418) and 37.13±18.60 (n=297) respectively. The *t*-test for differences in means for animals slaughtered during the month of November as compared to December and January showed statistical significance ($p < 0.05$).

3.7 Animal slaughtering personnel and competency

The study examined the man power and competency of the slaughtering personnel in broiler farms, fattener farms and cattle slaughterhouse as given in table 1. The results showed that 81.8% (n=613) hired external personnel for slaughtering while only 18.2% (n=136) used their own farm/premise personnel for slaughtering animals. For the competency in slaughtering methods, 86.5% reported no formal training (n=648) followed by 9.7% not having heard of such requirements (n=73) and 3.7% with some basic training (n=28) on slaughter methods.

Table 1: Man-power and competency in slaughtering methods

Type of farm/premise	Slaughter personnel		Slaughter competency		
	Farm staff	**Hiring**	**Trained**	**Not trained**	**Not known**
Poultry broiler farm	54	146	15	167	18
Pig fattener farm	82	466	13	480	55
Cattle slaughterhouse	0	1	0	1	0
Total	**136**	**613**	**28**	**648**	**73**

The results align with findings from Whittaker (2005) and Norton and Rafferty (2010), suggesting reasons such as specialized expertise, cost-effectiveness, or a shortage of trained staff on farms which can impact farm productivity and efficiency. While the slaughtering workers are skilled through hands-on learning, the absence of structured training programs raises concerns about consistency and best practices in animal slaughtering and highlights the need for formalized training initiatives to improve efficiency, ensure animal welfare, and standardize methods across the food processing industry.

3.8 Ante-mortem procedures

The study showed that 95.0% (n=190) of the broiler farms have the lairage (holding facilities) while 5.0% (n=10) did not have. On the other hand, only 3.28% (n=18) of the pig fattener farms reported owning a holding facility, while the vast majority, 96.72% (n=530) did not have. The cattle abattoir in Tsirang lacked lairage or holding facility, despite the slaughterhouse being established in the early 2000s. The study by Nielsen et al. (2019) reported that this facility is

important for maintaining the quality of meat and ensuring proper animal welfare. However, insufficient animal slaughtering facilities including lairage and poor meat handling practices continue to be a major issue in Bhutan (Dorjee 2011). The current findings suggest that welfare issues are prevalent across all species, with pigs and cattle being at a higher risk than others suggesting that welfare within a location need to be improved.

Out of 749 farms and facility surveyed, 60.5% (n=453) responded that AM inspections are done while 39.5% (n=296) did not do AM inspection. Notably, the AM inspections were done 100% in cattle slaughterhouse and 72.4% in pig fattener farms while only 27.5% of poultry broiler farms reported doing AM inspection. 92.3% of the AM inspections were done by the respective Livestock Extension offices and 7.7% were carried out by BFDA personnel. The study done by Andoni et al. (2023) reported that the AM inspections are crucial for identifying and addressing potential health issues in animals before slaughter,

which can significantly impact meat quality and public health.

3.9 Animal slaughter process

3.9.1 Animal restraint before slaughter

Table 2 shows the types of restraints deployed prior to slaughtering animals in broiler farms, fattener farms and cattle slaughterhouse. Overall, the study indicated that 78.4% of the farms and slaughterhouse did not restrain animals prior to slaughter. Out of 21.6% who used restraining techniques, 37.7% were upright restraint followed by 26.5% crate restraint, 21.0% leg restraint, 8.6% head restraint, 3.1% casting and 3.1% suspension/inversion restraint. The crate restraint was predominantly for pigs and suspension/inversion restraint was for poultry.

The goal of properly restraining an animal is to minimize its reactions and movement, ensuring that the stunning or slaughter process is accurate, swift and causes minimal distress. A study by Aghwan and Mac-Regenstein (2019) found that controlling an animal's movement requires a body lift that gently engages with the animal to limit its motion, along with a head restrainer that fully exposes the neck and throat for cutting while also stabilizing the head to minimize movement.

3.9.2 Stunning procedures

The stunning procedures used prior to animal slaughter were assessed for the study as illustrated in Table 3.

Overall, 82.6% of the poultry and pig farms did not use any stunning methods. Out of 18.5% (n=37) broiler farms that used stunning, 29 farms deployed mechanical stunning through blunt object hit and eight farms used electrical stunning. Out of eight

Table 2: Types of animal restraints before slaughter

Species	Types of restraints						
	No restraint	Head restraint	Leg restraint	Upright restraint	Casting	Suspension/inversion	Crate restraint
Poultry	149	12	33	1	0	5	0
Pig	438	1	1	60	5	0	43
Cattle	0	1	0	0	0	0	0

Table 3: Stunning methods used in the study areas

Species	No stunning	Stunning methods		Electrical stunning	Gas stunning
		Mechanical stunning			
		Captive bolt stunning	Sharp/blunt object hit		
Poultry	163	0	29	8	0
Pig	456	2	89	1	0
Cattle	0	0	1	0	0
Total	**619**	**2**	**119**	**9**	**0**

commercial farms that used electrical stunning method, four were in Sampheling Gewog, one in Phuentsholing Gewog under Chukha district and three were in Tading Gewog under Samtse district.

Similarly, out of 16.8% (n=92) of the fattener farms that used stunning, 91 farms used mechanical stunning (2 captive bolt and 89 sharp/blunt object hit) and one electrical stunning method. The captive bolt stunning was mainly used by NPiDC and one commercial piggery farm in Gelephu Gewog under Sarpang district. The electrical stunning method was used in Phuentsholing Gewog under Chukha district.

The cattle slaughterhouse in Tsirang used mechanical stunning through sharp object hit. Dorjee (2011) described the use of mechanical stunning method deployed in Tsirang abattoir, by percussive blow behind the nuchal crest using an axe, as too inhumane. So the owner introduced the penetrating captive bolt stunning method in 2011, which was observed to be very effective method, though the use of stun gun was legally banned in 2013 under the provisions of the Fire Arms and Ammunition Act of Bhutan.

Stunning is primarily carried out as a procedure of animal immobilization to let easier and safer manipulation of the animal (Aghwan 2019). Additionally, from a welfare point of view, the primary aim of stunning is to render the animal insensible so that it may not feel pain during slaughter (Nakyinsige et al. 2013). However, stunning of animals before slaughter is not permissible in the majority of Muslim countries (Nakyinsige et al. 2013), which is not a major issue in Bhutan.

The high percentage of non-stunning procedure practiced in the study areas suggests a potential gap in welfare practices. The relatively low adoption rates of stunning in poultry or pigs could reflect various factors, including cost, availability, or lack of awareness about the benefits of stunning for animal welfare (Sinclair et al. 2019). The pre-slaughter stunning should be immediately followed by bleeding within 60 seconds either by neck-cutting or by thoracic stick to prevent the risk of recovery. This is especially so if a non-penetrating device is used.

3.9.3 Animal slaughter methods

Figure 8 shows the various methods of slaughter used in the broiler and fattener farms across the six districts. Among 200 broiler farms, 48.5% used suffocation method followed by 30.0% manual neck dislocation, 6.0% decapitation, 5.5% each by bleeding and thoracic stick and 2.5% strangulation. 2.0% of the farms did not use any slaughter method after stunning. The study carried out by Ripplinger et al. (2024) and Gerritzen (2006) showed suffocation and manual neck dislocation as the predominant slaughter methods in poultry indicating the need to improve awareness and adoption of more humane slaughter techniques that could enhance animal welfare and meet modern standards.
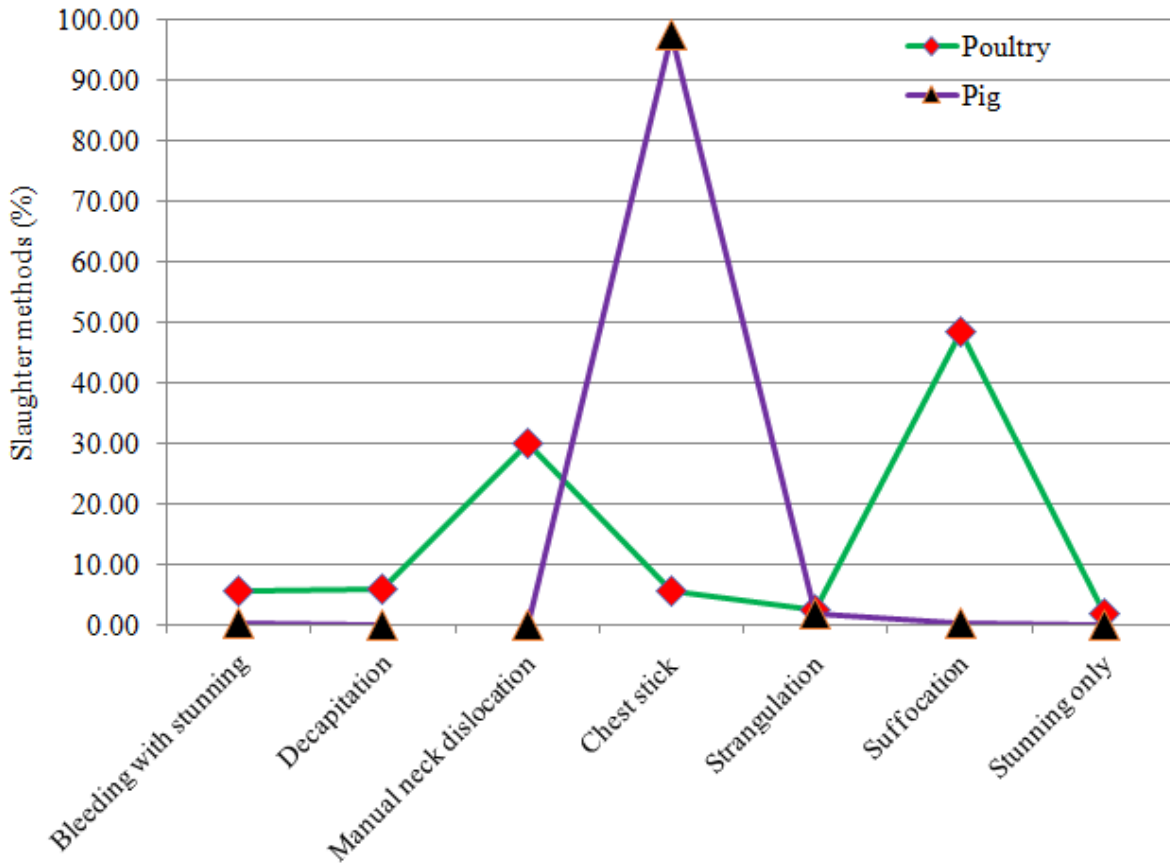
Figure 8: Slaughter methods used for broiler and fattener farms

Out of 548 pig fattener farms, 97.6% used chest stick for slaughtering pigs followed by 1.8% strangulation, 0.4% suffocation and 0.2% bleeding after stunning. This distribution highlights stabbing as the most widely practiced slaughter technique in the piggery farms. A study by Velarde and Dalmau (2024) reported that pigs are usually bled by chest sticking for humane slaughtering and better welfare in slaughter pigs.

The slaughterhouse in Tsirang used bleeding out in all cattle by severance of blood vessels in the neck after stunning. This approach ensures that animals are first stunned to minimize distress before bleeding, reflecting a commitment to humane practices in the facility. The uniform use of this method highlights its importance in maintaining animal welfare and adherence to standard slaughtering procedures.

The Article 7.5.1 of the *Terrestrial Animal Health Code 2024* describes the acceptable stunning and slaughter methods and the associated animal welfare issues in each food animal species (WOAH 2024). In the absence of standard slaughter facilities and lack of competent/trained personnel for animal slaughtering in Bhutan and to minimize risks to personnel, the best method for stunning would be through use of captive

bolt (penetrating or non-penetrating) in cattle and pigs and electrical (preferably water bath) in poultry. This should be followed by suitable slaughter methods either through bleeding by neck stab and chest stick in cattle and pigs and by neck severing in poultry.

3.10   Post-slaughter processes
3.10.1. Post-mortem inspection

The study examined the practices related to post-mortem inspection after slaughter of animals and the personnel engaged in performing the PM examinations (Table 4). Overall 53.9% (n=749) of the farms and slaughterhouse reported conducting PM inspection after slaughter of animals. 52.7% of the PM inspections were performed by livestock extension staff followed by veterinarians (25.5%) and BFDA officials (21.8%).

A significant proportion of farms (46.1%) in the study areas did not perform PM inspections after slaughter of animals indicating non-compliance to standards and procedures established for AM and PM inspections under the Livestock Rules and Regulations 2017. This code of AM and PM

inspections requires to be applied throughout the food chain, starting at the farm of origin, so that fresh meat produced from the slaughtered animals are safe and fit for human consumption. However, the difficulty in implementing at the field level may be due to various technical and logistical reasons as reported by Dorjee (2011).

3.10.2. Post-slaughter processing
The practice of post-slaughter processing of meat was assessed during the study. A significant percentage of poultry and pig farms reported following scalding and evisceration processes after slaughter (Figure 9).

Deboning, portioning and packaging of chicken were meager whereas deboning and packaging were not practiced in fattener farms indicating potential areas for product diversification. 44.9% (n=246) of fattener farms reported following portioning of meat.

Chilling and storage of chicken and pork were done by commercial poultry and fattener farms at 39.5% (n=79) and 21.5% (n=118) respectively indicating sale of hot (unrefrigerated) meat to retail meat markets and higher consumer preference in the country.

Table 4: Post-mortem inspection and personnel engaged in PM examination

PM Inspection	PM - Yes				PM – Not performed
	BFDA	RNREC/LEC	Veterinarian	Farm personnel	
Poultry	86	40	0	0	74
Pig	1	173	103	0	271
Cattle	1	0	0	0	0
Total	**88**	**213**	**103**	**0**	**345**
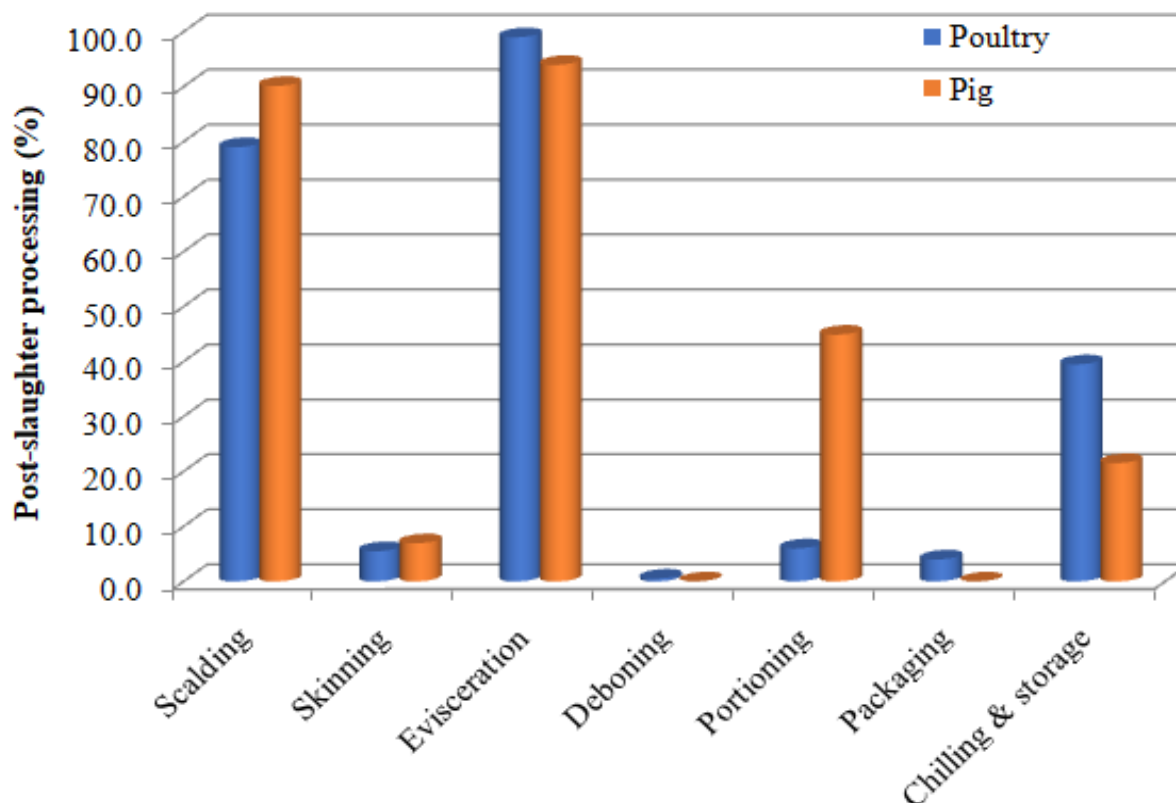
Figure 9: Post-slaughter processing of meat in poultry and pig farms

The cattle slaughterhouse in Tsirang followed skinning, evisceration and portioning before the meat is transported to retail markets in nearby districts.

3.10.3. Transportation of meat products after slaughter
Table 5 shows the mode of transportation and cold chain facility available in the vehicles during supply of meat products to retail meat markets from the farms and slaughter facility. 76.0% (n=152) of broiler farms used hired vehicles out of which, 46.7% had inbuilt modern cold chain facility and 29.6% did not have cold facility. Similarly, 88.1% (n=483) of fattener farms used hired vehicles with 51.2% having inbuilt cold chain facility and 39.1% without cold chain facility. 23.6% of broiler farms and 9.7% of fattener farms used their own

vehicles to transport the meat products and majority of the owned vehicles did not have cold chain facility. A few proportions of broiler and fattener farms did not transport meat to retail meat markets as the meat products were sold within the locality. The cattle slaughterhouse relied entirely on hired vehicles without cold chain facility.

Overall, 53.6% of the farms fulfilled the standards for transportation of meat as prescribed in MoAF (2017) wherein about 53.8% of poultry farms and 53.6% of fattener farms met the standards. The use of transportation without cold chain facility may compromise meat quality and safety especially during longer duration of transportation and it highlights the need to emphasize the strict enforcement of Livestock Rules and Regulations 2017.

Table 5: Transportation of meat products after slaughter

Transportation of meat products	Poultry	Pig	Cattle
Own vehicle with cold chain facility	14	13	0
Own vehicle without cold chain facility	33	39	1
Hired vehicle with cold chain facility	93	274	0
Hired vehicle without cold chain facility	59	209	0

3.11 Destination of gut contents and tissues unfit for human consumption

The study assessed the destination of the gut contents and tissues unfit for human consumption after slaughter of animals to understand the disposal mechanism and possible adverse impacts on the environment. The results showed that 57.1% of the respondents (n=645) disposed the gut contents into the biological pit followed by 25.3% use in agriculture as farm yard manure and 17.5% drained directly into the environment. Only a small proportion of 0.2% respondents used the gut contents for biogas production which was reported by a fattener farm in Tsirangtoed under Tsirang district.

Similarly, 79.8% of the tissues unfit for human consumption (n=749) went into the biological pits and 19.9% being fed to animals. A 0.3% of the respondents in fattener farms in Samtse reported disposing unfit tissues through incineration and none of the farms or slaughterhouse used any treatments to dispose the tissues unfit for human consumption. The destination of the gut contents and tissues unfit for human consumption is illustrated in figure 10.

Overall, about 82.5% of the disposal methods for gut contents and 0.2% of the disposal methods for tissues unfit for human consumption met the standards prescribed in MoAF (2017). The high rates of gut contents being directly disposed into the environment and unfit tissues going into the biological pits suggest that the disposal mechanism for condemned carcasses, tissues unfit for human consumption and gut contents after animal slaughtering need to be reviewed and proper guidelines developed for the country.

3.12 Challenges and strategies to improve animal slaughter practices

Out of 749 respondents in the study, 74.5% (n=558) identified lack of modern abattoir facility as the major issue in safe and hygienic practice of animal slaughtering in the country. This was followed by limited access to appropriate stunning and slaughtering tools and equipment (41.7%) and lack of competency and training on restraining, stunning and slaughtering procedures (38.7%).

55.6% (n=416) of the respondents believed that the establishment of modern abattoir along with easy access to stunning and slaughtering tools and equipment would significantly improve the standard slaughter practices and welfare of the animals. 45.7% (n=342) of the respondents were keen to acquire specific training on acceptable and humane methods of animal slaughtering practices. Further, 27.0% (n=202) suggested that the government should provide subsidies for establishment of abattoirs to
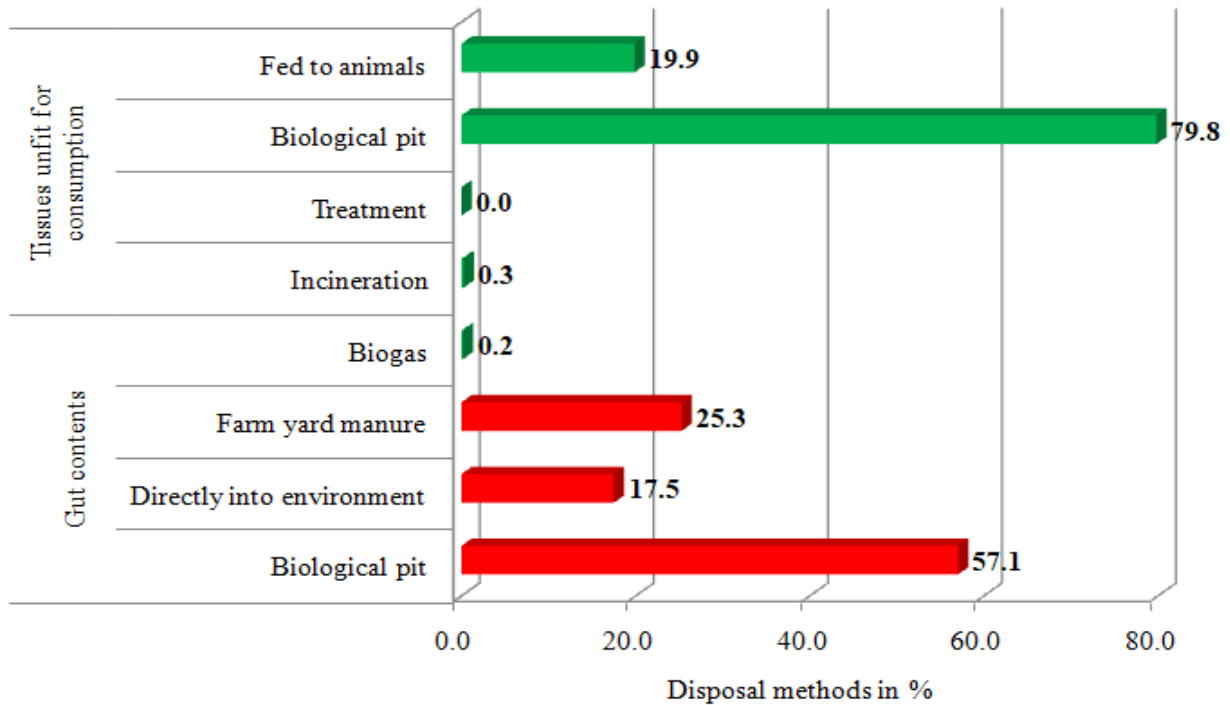
Figure 10: Destination of gut contents and tissues unfit for human consumption after animal slaughtering in Bhutan

interested individuals and for procurement of appropriate stunning and slaughtering equipment or facilities.

4. CONCLUSION

The assessment of animal slaughter practices across broiler and fattener farms including one cattle slaughterhouse revealed substantial variations in methods and standards impacting meat hygiene, safety and animal welfare in the country. The WOAH *Terrestrial Animal Health Code 2024* provides comprehensive guidelines on acceptable stunning and slaughter methods and the associated animal welfare issues in each food animal species. Bhutan, as a WOAH member country, needs to incorporate these guidelines into the national

standards where relevant, enact relevant regulations and implement the guidelines paying particular attention to the best suitable methods and acknowledging the religious, cultural and ethnic requirements. The final animal welfare outcome depends upon the commitment of all stakeholders involved including producers, marketers, technicians and animal handlers; guided, advised and supervised by regulators, veterinarians and other related professionals (Shimshony et al. 2005).

Specifically, the study recommends the ministry, department and relevant stakeholders to implement the following strategies to improve animal slaughter practices and welfare in the country:

❖ Encourage establishment of modern abattoirs by interested private individual/group/cooperative for any food animal slaughter with or without subsidy.

❖ Enforce stunning through use of captive bolt (penetrating or non-penetrating) in cattle and pigs and electrical (preferably water bath) method in poultry species in the country. This should be followed by suitable slaughter methods either through bleeding by neck stab or chest stick in cattle and pigs and by neck severing in poultry.

❖ Ensure welfare of food animals during each stage preceding the death of an animal which includes the unloading, lairaging, moving, restraining, stunning and bleeding processes.

❖ Facilitate easy access to preferable stunning and slaughtering tools and equipment for the farms and slaughterhouses producing animal food.

❖ Train employees or personnel involved in animal slaughtering on restraining, stunning and slaughtering methods and associated animal welfare issues.

❖ The traditional meat inspection procedures (AM and PM examinations) can only indentify physical abnormalities and classical zoonotic diseases. The procedures cannot detect microbiological hazards and harmful residues which are increasingly becoming the most important public health risk in meat and meat products. The tools should thus be integrated and supported with appropriate laboratory tests, along with a close link between the abattoir and livestock production.

❖ This study doesn't entail the acceptable methods of stunning and slaughter of animals for disease control purposes. The mass culling undertaken to control the frequent outbreaks of ASF, brucellosis and HPAI H5N1 in the country have reported use of inappropriate slaughtering methods and related welfare issues. It is therefore recommended that the methods for slaughter of animals for disease control purposes may be adopted similar to animal slaughter practices in food animals.

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